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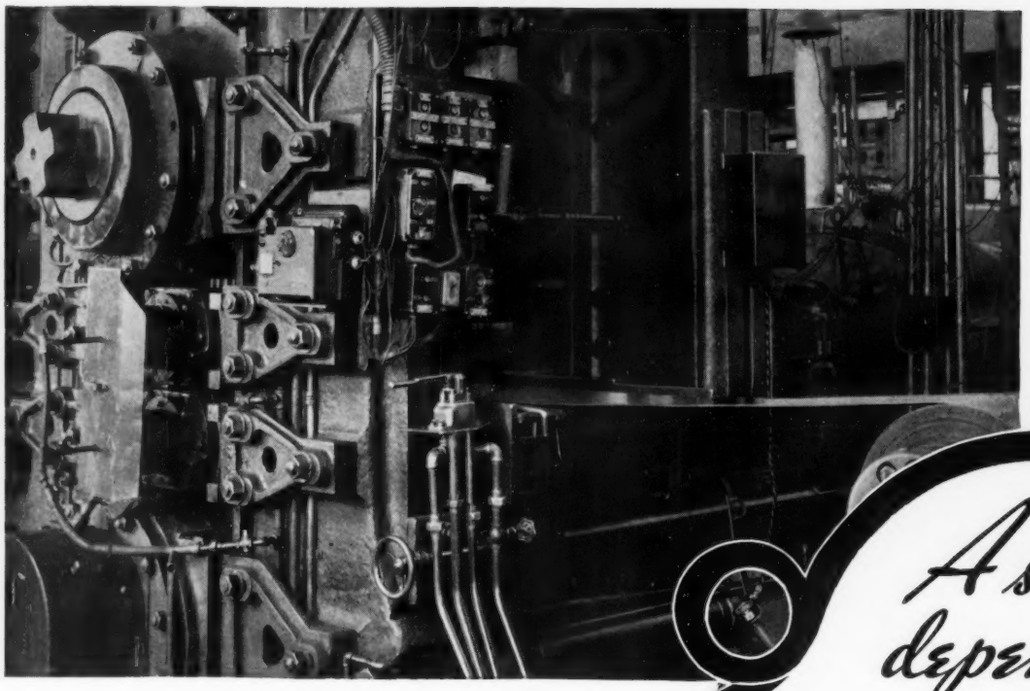

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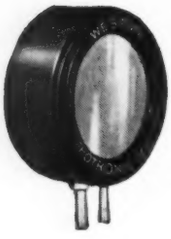

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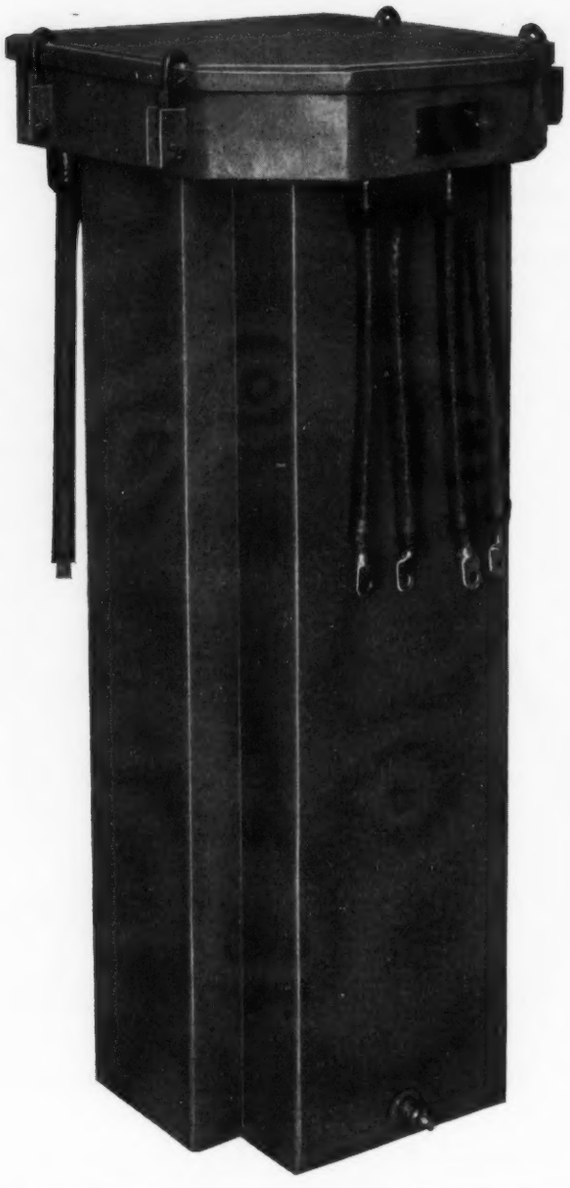

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ELECTRICAL WORLD

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July 7, 1934

L. W. W. MORROW, *Editor*

Fifty Years of Electrical Engineering

LAST week electrical engineers celebrated the fiftieth anniversary of the American Institute of Electrical Engineers. Pioneers of the early days, engineers on the present firing lines, educators and junior engineers who look to a professional future joined to celebrate the glorious record of accomplishment, of tradition, and of service established by the profession in its relatively short life. The institute has acted as the storehouse for knowledge, as the forum for discussion and education and as a symbol for the ideals of the profession. It has a history and a record deserving of the happy and stimulating celebration held in Hot Springs.

An anniversary stirs memories of the past and induces a look toward the future. Fifty years ago a few teachers and electricians felt the need of an organization and had faith in the future. These men had little theoretical knowledge, few facilities for experimentation, a limited field of electrical applications, and yet they had the enthusiasm and the vision to found the institute. And the principles they stated have served as guides over the enormous expansion that has taken place in the industry and the profession in the past fifty years. The institute has kept the faith of its founders. Despite many temptations to forsake the broad highway of professional electrical engineering, it has gone forward and flourished as a professional society.

And in these days of change the institute should look ahead to an even more remarkable future if it will maintain the principles and purposes for which it was established. Improvement and change in organization to meet new needs may be advisable, but the old objectives should be sought—unity as a profession, a record of the art, an educator of engineers and the creator of professional standards and ideals.

Undoubtedly professional individualism will be less in the future, for the trend is toward group action. The present endeavor is to elevate the standards of the profession and to regiment engineers into a restricted group by law, by examination and by highly selective processes. The engineer is to be established upon a plane comparable to that of the lawyer and doctor, and engineering schools, professional societies and practicing engineers must adjust themselves to these new specifications. The cause is worthy and the institute as the mouthpiece for electrical engineers should play its part in this program and yet retain the older activities that have proved to be so valuable in the past. It should continue to make a place in its membership for all interested in electrical engineering, and it should not neglect its educational functions in order to accent its professional obligations.

PERHAPS the most critical problem for the institute is encountered in the demand that it act in non-technical matters. In principle, engineers should participate more actively and directly in social and economic affairs, and the professional societies are encountering an increased pressure to this end. Some go so far as to state that it is their duty to take steps to advance the economic status of individual members and to take direct action in society and industry to bring this about. All may agree with the social concept that lies back of these suggestions, but it is our opinion that the institute cannot and should not function as

the agency to carry out these non-professional activities. This work for all engineers, within the limits of professional ethics, should be done by the Engineers' Council or other joint engineering organizations. The institute has had strength and appeal because it chose for its function the support and development of the scientific basis for electrical engineering. It should continue to grow in this spirit of professional service and professional cooperation that has nurtured it in the past.

We congratulate the institute upon its record and are glad to join with the electrical industry in celebrating this fiftieth anniversary. We have faith in the industry and the profession and believe the future will bring forth new names to place with those of Weston, Edison, Sprague, Steinmetz, Lamme, Carty, Thomson and others to stand for those ideals and accomplishments that made the present celebration so glorious. The institute will continue to be the lighthouse on the course to the professional haven of the future.

Expenditure for Load Building

It takes money to build a power system. More than thirteen billion dollars have been spent in America that way. It has become an accepted principle among engineers that it is good business to extend a line that will return its cost in, say, three years.

When it comes to spending money to build more load, however, a strange complex sets in. Sales managers are told that they must show black ink on their operations for each year. Refrigerators, ranges and water heaters are held back unsold for lack of the commercial courage to invest money in building up the consumption of connected customers.

George Whitwell, at the recent Atlantic City convention, stated bluntly that the industry must change its attitude toward spending money for selling. If the threat of more taxes and lower rates is to be met, he said, 10,000 ranges must be sold in cities where now they plan for 1,000, and instead of 500 water heaters as a campaign bogey, 5,000 should be the goal. He is right. It is time to face the facts and decide whether load building is as important as system building?

Funds for construction are appropriated with confidence because it all goes into capital account and the new line can be seen when it is built. But the money is no less spent than when it goes into sales promotion. All that the investment can return in either case is revenue from customers. And dollars from old customers are as good as dollars from new customers.

It is just a matter of whether or not the job is to be done quickly. The load is there. It can be sold. But to get this added business, money must be plowed in and harvested over several years to come. For big returns it must be done in a big way. And the industry must learn to think of million-dollar investments in sales promotion with the same assurance that it thinks of similar expenditures for construction.

Machine Controls Improving

Notable progress in electric control applications to specialized production machinery strikes the close observer of factory processes in these days of economy. In a metal box plant the installation of automatic controls on cutting, shaping and soldering machines has lately reduced the labor requirements in this section of the manufacturing program by two-thirds, besides preventing cumulative damage in case material becomes bent or obstructs the flow of product units through the department. Solenoid and magnetic types of control are so well articulated with the various machine motions and product transfers that if temporary stoppages of sub-machine drives occur, these are automatically resumed when the offending product units are cleared. In one such plant nearly 3 kilowatts of motor-generator equipment is required to maintain direct-current service at scores of necessary points where automatic controls are in use, and there seems to be no limit to the possibilities of this kind of non-human supervision. The designing engineers have gone far beyond the common objective of preventing "pile-ups" of material by stopping motors automatically on the supply side of a material sequence in case trouble occurs further along the line.

There is a field for valuable service to industry by many electrical manufacturers and control designing and producing organizations in such applications to highly individualized processes. Some of these applications have grown out of home-made "hook-ups" which have worked well and others have been the fruit of careful and complete analysis by factory superintendents and electrical engineers of their own and other concerns, coupled with wiring diagram and specification work which compares favorably with much heavier engineering.

50th Anniversary Finds A.I.E.E. Planning Future of Profession

THOSE who attended the A.I.E.E. annual convention at Hot Springs, Va., divided their time and thought between the two extremes of practicalized theory and of unified professional prestige. Celebration of the 50th anniversary of the institute put the members in reflective and projective moods that encouraged discussion of the great technical achievements of the past half-century and the impending solidification of the ranks of the engineers of the future in meeting their professional responsibilities to the public. That this portends not the slightest waning of interest in things technical was demonstrated by the technical program of the closing three days.

Electronic devices were reported as moving into applications in power conversion, synchronizers, voltage regulators and telemeters. Criteria for the sufficiency of insulation resistance in machines in service were subjected to new proposals of interest to engineers engaged in preventive maintenance. Fabrication and tests of line insulators in several manufacturing plants and in the field was the topic of discussion at a session which therefore affords a comprehensive picture of the technique of the insulator art.

Totalizing of load and telemetering with and without supervisory control were other subjects actively surveyed. Expansion of an existing generating station to include a 165,000-kw. alternator in space originally planned for a 50,000-kw. unit led to bus and generator lead problems, the solution of which was the feature of one of the power generation papers. Most prolific of discussion at the measurements session was a paper which carried data on refinement and extension of the sphere gap as reference standard for both impulse and commercial frequency measurements of high voltage.

Education and the Profession

THE education of engineers and the improvement of their profession was the theme of the first session on Tuesday. C. L. Dawes presented a paper showing how the Harvard plan of education was developed to encourage the initiative of the students. This plan is based upon the student selecting his courses, consultation with his faculty adviser, outside reading and study and the development of the student's responsibility and originality in the classroom and laboratory.

Apparently this idea is applied to a considerable extent in other schools through several methods adapted to local conditions. W. H. Timbie described the initiative development plans of the Massachusetts Institute of Technology, wherein the student was required to program his courses and work. At Pennsylvania and at other colleges through options, consultation with faculty members and other means the students are encouraged to rely upon themselves for their instruction.

A suggestion that it would be well to study present engineering methods of education was made by L. W. W. Morrow. He pointed out that industry demands had shifted toward the use of a fewer number of professional engineers and a larger number of men to enter business after having had a technological and cultural training. The licensing laws had narrowed the definition and function of the engineer to the professional class, yet mechanized industry felt a necessity for men with a technological background.

D. C. Jackson pointed out that engineering education was in a state of flux, yet the essential principles of education were permanent and the engineering process of thought and action was still the best available. He demonstrated it to be the function of the schools to educate men and not to produce engineers for they must be the product of later experience and study.

C. L. Dawes stated that an elevated standard for students entering the profession of engineering was necessary and that possibly a combination of the business course and engineering course could be developed as the best education for those who wished to enter upon a business career.

Dr. William McClellan stated that the term engineer was too broad today and that this was reflected back upon the educational system. He said the engineer was a functional specialist and that educators should bear this in mind in their teaching of students. Yet the education of those who wished to enter business was necessary and technology was part of the training. In his opinion the tendency to broaden the term engineer to include social and economic elements of action was not well conceived.

C. F. Harding agreed with the conclusions of Mr.

Morrow to a large extent and stressed the necessity of unity in perspective and method of teaching in courses that combined technology and economics.

In other instances educators suggested the use of options, the addition of a fifth year and other plans to introduce, for some of the students, the courses that would better prepare them for a business career.

C. F. Hirshfeld said that a good engineer was a broadly educated and cultured man and that the roots of this development rested in the colleges. The content of courses and other details were not essential as contrasted with the engineering method of thought and action.

H. R. Woodrow said that the young engineer frequently thought the profession owed him a job and that this attitude was false. Today, as never before, the development of a career rested upon the individual.

Engineers of the next generation as influenced by recent trends was the subject presented by C. F. Hirshfeld. The state licensing laws, the trend toward definition of engineers, the move to improve engineering as a profession all united to force a contemporaneous and significant organization for co-operation. Facts forced the profession to act and the Engineers Council for Professional Development was at work as a co-operative group. He pointed out its purposes and asked for support of the institute in its general plan. He stated restrictions might hamper action at this critical stage. Dr. J. B. Whitehead pledged the support of the institute to the general program of the E.C.P.D. and stated that every engineer would give sympathetic encouragement to it during the difficult task before it.

Revision of Sphere Gap Calibration in Prospect

PREFERENCES for the resistance divider and sphere gap as reference standards for high-voltage measurements featured the instruments and measurement session. J. R. Meador, in his extensive report on the recalibration of the sphere gap strongly favored the gap because of its simplicity and availability to all laboratories, and, while acknowledging the comparable precision of the divider schemes, felt their complexity made them less desirable. All who discussed the paper agreed that the A.I.E.E. sphere gap standard needs to be revised and elaborated in its stipulation of surrounding conditions because these are known to influence the reading and account for some of the "strays." Mr. Meador's general conclusions were that

1. The sphere gap calibrations that originally were made on 60 cycles are fairly accurate for 60-cycle and negative polarity impulse measurements. The average error is of the order of 2 per cent.

2. Sphere gap standard curves that were not based on test data are inaccurate for 60-cycle, negative polarity impulse and positive polarity impulse measurements throughout most of their calibrated range of spacings. These errors in some cases are as high as 15 per cent.

3. In general, all of the standard sphere gap calibrations are inaccurate for impulse measurements on positive polarity at spacing large in proportion to diameter.

One of the advocates of the resistance or capacity divider schemes was P. L. Bellaschi, who is joint author of a currently published analysis of the sphere gap calibration. He finds positive and negative calibrations identical for gaps up to approximately one-fourth the sphere diameter. For wider openings the positive calibration rises uniformly above the negative, exceeding it as much as 7 per cent for the 25-cm. sphere. The present calculated curves for the larger sphere gaps are obviously in substantial error not only for impulse measurement but also for 60-cycle measurement.

In view of the remaining uncertainty element in these calibrations, what test limits and tolerances should be employed by inspectors in acceptance test was a question asked by W. A. Hillebrand, but which passed unanswered. Clearances from grounded objects should be carefully stipulated in any revision of the specification, according to J. T. Lusignan. K. B. MacEachron reminded the listeners that illumination of the small spheres at small gaps is desirable in order to eliminate their time lags. F. D. Fielder stated that the differences in calibration between General Electric and Westinghouse had been narrowed down so as to fall between 0.5 and 3 per cent for the various spheres. R. E. Hellmund urged that the gaps used be confined to from 40 to 50 per cent of the diameter because all sizes of spheres give consistent negative sparkovers in this region. While admitting several weaknesses of the sphere gap, C. M. Foust felt that the advantages, especially the simplicity, outweighed them. J. E. Clem drew the important conclusion that where the new calibration curves are used for insulation testing a greater spacing will be used for the same indicated voltage, thus imposing a test voltage higher than previously. Operators will thus get better equipment for a given rating.

Why Selsyn, synchro-tie, auto-syn?

Lack of a generic name to cover the position apparatus variously described by such confusing trade names as Selsyn, synchro-tie, etc., was deplored by Paul MacGahan in discussing the Linville and Woodward paper. He also reported that the telemeter report prepared in 1932 under the joint auspices of the measurements and automatic stations groups was being brought up to date. It gives the functioning principles, operating limits, sensitivity and accuracy of all forms of telemetering, including the improved pilot coil scheme described in the paper by Lunas and Bernarde.

Insulation Co-ordination and Rectifier Control Discussed

INADEQUACY of the prevailing criteria for insulation of low-voltage machinery was one feature discussed in the machinery session. Co-ordination of insulation of transformers was moved one step nearer unity by the Bellaschi-Vogel paper and by those who discussed it. Perfection of grid control of rectifier voltage, including the inverter function, and benefits to be derived from split-winding transformers comprised the rest of the contributions at this session.

In his paper R. W. Wieseman presented formulas and nomograms which take fuller cognizance of design and operating variables than either the A.I.E.E. rule of E / (kva. + 1,000) megohms at 74 deg. C. or the A.S.A. revision $E \frac{(\text{kva.}}{100} + 1{,}000)$. In the discussion it de-

veloped that some use $3E$/kva., others E/1,000, and still others simply 1 megohm for all machines. P. L. Alger disclaimed any intention to supplant the two prevailing rules by Wieseman's more intricate exponential formulas, but he did hope the availability of the nomograms would encourage operating engineers to make frequent checks of insulation resistance and thus build up a pool of field data which could be correlated with failure records and thus set the minimum permissible level of insulation deterioration. A communication from J. G. Biddle's staff said Meggers hold their calibration well and that they were disposed to favor the simple 1 megohm rule in preference to the complexity of the proposed formulas.

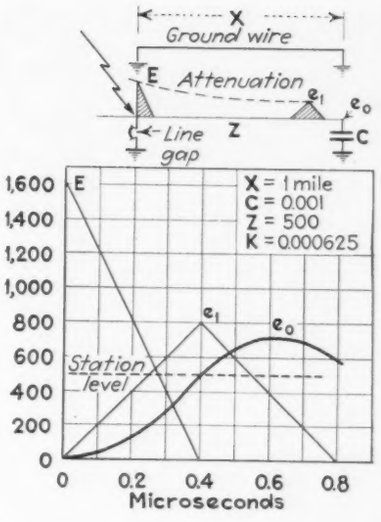
More agreement on co-ordination of transformer insulation

That Bellaschi and Vogel had said in their paper that the insulation and point gap characteristic curves are closest at 2 microseconds was something V. M. Montsinger considered too important to pass over without comment. He interpreted this to mean that if a gap just protects a transformer at 2 m.s. time there is no danger of it not protecting it at any other time of flashover; the data in the paper seemed to him to indicate (1) that the equivalent rod-gap spacing must be continually decreased as the waves become shorter and steeper and (2) the volt-time curves will cross if the insulation strength is above, but not too far above, the gap strength for long waves. Mr. Montsinger expressed the belief that it is not possible from an economic standpoint to protect transformers from severe direct strokes of lightning simply by either increasing the insulation or by reducing the line insulation at or near the station. Ground wires, arresters and rod gaps seem to be part of the present answer.

Expulsion protective gaps, in conjunction with good grounds, may be used on several poles adjacent to the station on lines where no definite limitations of an incoming wave are provided. K. B. McEachron said the traveling wave potential could in this way be limited to values of the order of from six to eight times normal line to ground crest potential. As an added precaution the last gap or two could be tied in with the station ground by using a buried conductor. If a reasonably definite level of line insulation through the use of the expulsion protective gap or other means is established, a greater dependence can be placed upon the arrester's performance than is now the case when there is no limit placed on the line insulation except the wood pole itself. If the station and associated overhead lines are protected from direct strokes and a modern arrester installed in the station, there seems to be no good reason for installing gaps in the station. If arresters are not used the station gap to be effective for direct stroke conditions requires either an extremely low setting or else shielding of the line over a considerable distance.

Requisite length of ground wire

This latter point was amplified by L. V. Bewley, who showed how to compute the requisite length of line shielding for direct stroke protection of stations on both low and high voltage circuits. If the station capacitance is small in value this co-ordinative shielding may have to extend several miles in order to effect the proper attenuation. Thus in the accompanying illustration the computed curves show that if the station voltage reaches



a maximum of 720 kv. and the permissible voltage at the station is to be 530 kv., then, by trial, the appropriate length of ground wire is found to be 2 miles. This is with a station capacitance of 0.001 mfd.; for negligible capacitance the ground wire would have to run out 5 miles. In circuits equipped with reliable arresters the length of ground wire need not be longer than half the length of the chopped wave. That practically means there is then no real need for extending the co-ordinative ground wire for more than a normal span away from the station.

There is some evidence, said J. E. Clem, that switching surges in excess of four times normal voltage are fast enough to have an appreciable impulse ratio. In general, they are relatively slow and 60-cycle insulation characteristics suffice in dealing with them. As to lightning, it is appropriate to consider complete protection or partial protection. Complete protection calls for adequate direct stroke shielding and a "Thyrite" arrester; no gap is necessary except as a secondary defense against loss of the two protectors provided. Partial protection may place all reliance on the arresters by omitting the shielding; nearby direct strokes may in part be defeated by a gap set low in relation to the test gap. If, on the contrary, it is the arresters which are omitted a low gap would recover some protection. A gap alone will give a measure of protection that will be improved in so far as the setting is reduced below the setting used on the impulse test.

Repeated impulse testing does not damage the insulation. This is one dominant conclusion drawn by H. V. Putman from the Bellaschi and Vogel paper and a preceding one by the same authors. Mr. Putman also said that operating staffs are asking transformer manufacturers for difficult, intricate and expensive tests. Meanwhile the subcommittee is striving in the opposite direction of simplifying the stipulations and technique of the impulse test.

Wave-shape and voltage of rectifiers

If the commutation period in a six-phase diametrical circuit is so long that two anodes fire all the time, then the d.c. voltage will be less than that shown by the regulation curves, said Mr. Herskind in discussing the Journeaux paper. The former said that the loading co-efficients as used by either of them greatly facilitates the comparison of different rectifier circuits. He also injected the reminder in connection with the rectifier power factor that, whether the rectifier be used direct or as an inverter, the reactive kva. required must still be supplied by a generator, as is likewise necessary with induction alternators. Grid control was likened by L. R. Ludwig to brush shift in a commutator machine. But he felt that Journeaux was applying shift in a counter

direction, and then getting voltage regulation by stopping the arc at some compensating time. In comment on the Herskind paper he said that the duty on the grid-controlled rectifier is more severe than in the conventional one. The ignition type of control obviates this difficulty of increased duty encountered in grid control. A recent Swiss scheme of mid-tap anode promises well as costs can be reduced at the same time as giving considerable gain in power factor. R. E. Hellmund said that the inverter has been operated successfully with adjustable-speed motors, but that this is not an economical procedure for a wide range of application.

Calculation and measurements on rectifiers without grid control which are now in service in the field indicate an angle of overlap of approximately 25 deg. at full load, said F. O. Stebbins. Where a large angle of overlap is desired to give a wide range of voltage control the magnitudes of the harmonics in the output d.c. voltage become appreciable. Inductive load occasions different degrees of overlap and harmonic magnitude than non-inductive load.

Developments in Power Generation

A STATISTICAL survey of developed hydro power in the world was presented to the Friday meeting. About 47 per cent of this is in Europe and 40 per cent in the United States and Canada. The developed hydro represents only about 5 per cent of the total energy used and the committee stressed the exaggerated public opinion of the value of hydro to a lack of accurate information. A. F. Bang stated the survey to be very valuable and the most complete yet available. He stated that hydro power must be continuous to be most valuable and that industry would not synchronize its habits with river flow. J. B. Crane complimented the committee upon the valuable data and recommended that it continue the work.

Problems connected with voltage regulation, phase control and load control were presented by H. C. Forbes. With direct supply to a network, voltage is regulated at the generating stations in accord with system load schedules. Novel and accurate voltmeters aid in solving this problem. It is also necessary to control phase displacement in the usual sectionalized generating stations and between stations. Phase control equipment has been developed and applied to the bus sections and to the direct ties between stations.

H. W. Eales said the paper was a splendid contribution and that much research work yet remained to be done to make the a.c. network fully equivalent to the old d.c. network. C. M. Gilt stated that Hudson Avenue used reactor ties between bus sections that gave operators indications of loadings. He stated the necessity of some form of load transfer within a station to get economic performance. With the particular layout at Hudson Avenue and its double winding generators it has not yet been necessary to use special equipment for control of loading and phase displacement. A. H. Sweetnam stated that in most cases the network installation is only a small part of the utility system and the load or voltage regulation at the several generating stations is fixed by the requirements of the remainder of the system. In his opinion there should be further development of the network unit itself and negative sequence development is not the final answer.

The troubles treated in New York are quite special, in the opinion of F. M. Starr, for in few cases are secondary networks fed from more than one bus. In a few cases a small network may be fed by three or four feeders, each from a separate substation bus. In these cases the buses are tied together by cables. These ties may carry considerable load at times, but the phase-angle displacement is seldom if ever more than one degree.

A third paper dealt with a special bus problem encountered in putting a 165,000-kva. unit in the space previously occupied by a 50,000-kva. unit in Richmond station. A conductor to carry 7,000 amp. was needed and inductive heating of building metal had to be limited. After tests a special copper channel bus was chosen, a 6-in. channel for generator leads and an 8-in. channel for the bus. Special features were used to protect the metal in the building from heating, such as shielded copper bands and grids. Tests showed very satisfactory performance. H. W. Eales stated the copper channel conductor had been chosen for the new Reed station in Pittsburgh after exhaustive tests. H. C. Forbes told of early researches in skin effects in bus construction and pointed out the difficulty of direct measurements. He suggested the use of the high-frequency indirect method and miniature proportional structures. In his opinion a university or a manufacturer would find a demand for a permanent laboratory to make these measurements.

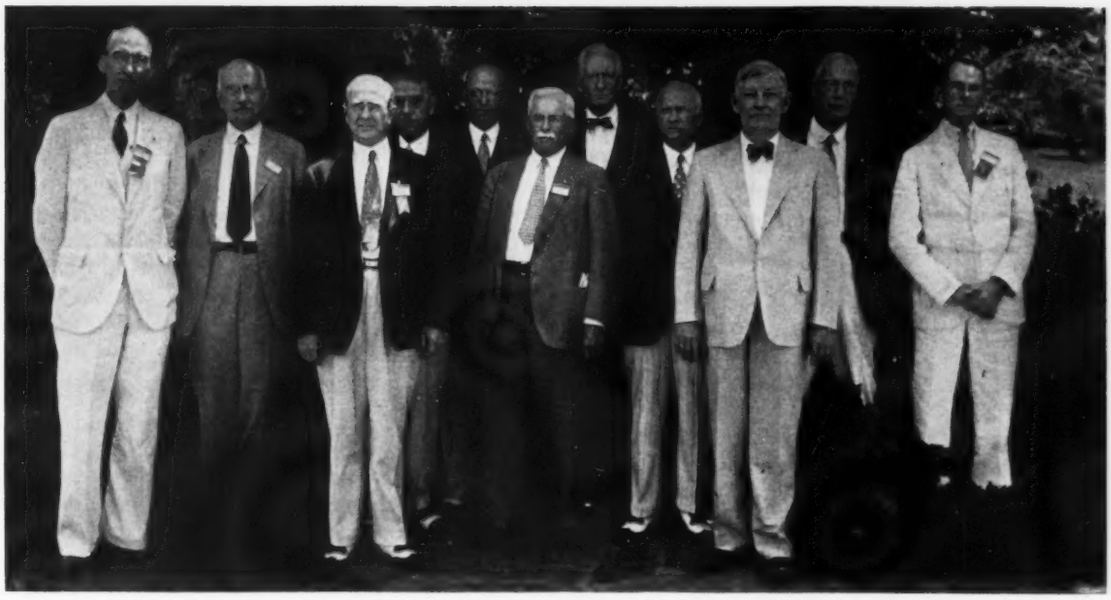
Useful data on heating of magnetic members were contributed in the paper in the opinion of W. M. Hanna. Direct value will come from the data on short-circuiting strips and grids. The heating of the bus was cared for by forced convection and more data should be made available on air velocities and volume. Also, the permeability, surface roughness and resistivity of the magnetic materials enter into the problem and data on these effects would be helpful.

An analytical and theoretical interpretation of the data was contributed by O. R. Schurig, with the conclusion that the tests cover a range that give data to select proper members and locations of the members in many other similar practical cases.

Communication and Power

SOME interesting new developments in power and communication were presented in one of the Tuesday sessions. A description was given of the use of metal shielding applied to communication circuits to prevent disturbance from outside fields. On the Pennsylvania electrification, for example, tape-armored cable has been installed because of the necessity of shielding. Measurements made on this cable gave a shield factor of 0.6 for small currents, 0.4 for normal and 0.2 for short-circuit current. Operation has been very satisfactory.

The shield factor on tape-armored cable is low because the steel sheath contributes to both the self and mutual impedance. It varies, however, with the magnitude of the disturbing field because of the presence of metal. Tape-armored telephone cable is used on many toll circuits and gives a high order of protection. This type of cable is a practical but rather expensive means of pro-



Past-Presidents of A.I.E.E. gather at Hot Springs, Va., at 50th anniversary of institute

The present president is at the extreme right and the president-elect at the extreme left

D. C. Jackson C. A. Adams C. F. Scott P. M. Lincoln
J. A. Johnson L. B. Stillwell A. W. Berresford J. B. Whitehead
H. P. Charlesworth B. J. Arnold William McClellan

tecting communication circuits from external fields if the sheath is well grounded.

C. F. Scott discussed the evolution of inductive coordination from the early days and told of the early disturbances created by the advent of alternating current. Modern types of tape-armored cable were described and discussed and this new development is operating very well, although limited in use by reason of cost to special applications.

Recent developments in carrier for power systems were described by T. Johnson, Jr. The equipment has been standardized on a unit basis and is operating very satisfactorily. Some of the recent applications are to relaying and to the opening and closing of sectionalizing and disconnect switches at a distance from the substation along lines which are tapped to serve local loads. In addition, carrier is being applied to supervisory control and to load control. It promises to have a rapid and useful application to the power industry in fields other than communication.

An interesting paper and demonstration was given on a new device named the "Compandor." It is applied to transatlantic radio telephone from New York to London and its function is to reduce the effect of static and equipment noise by the use of a compressor and an expandor made of vacuum tubes. It changes the relative levels of noise and voice levels and is very effective in increasing the time available for commercial communications.

Insulators and impulse tests

On Wednesday morning one technical session was devoted to a discussion of insulators and to the new standards for flashover voltages on insulators and gaps. The commercial laboratories now agree on impulse flashover test values on rods and gaps and this makes possible a rapid advance in the art. This agreement has been difficult and C. M. Foust outlined the methods and arrangements used by the several laboratories as indicative of the problems encountered. These were as follows:

1. Measurement of voltage amplitude across the test specimen by direct sphere spark gap comparison.
2. Measurement of voltage amplitude across the test specimen by preliminary calibration of surge generator output voltage, as indicated by sphere spark gap against surge generator excitation voltage.
3. Measurement of surge generator discharge circuit constants and calculation of voltage wave shape across the test specimen.
4. Recording of voltage wave shape across the test specimen by oscillograph.
5. Measurement of voltage amplitude and wave shape across the test specimen by oscillograph using voltage divider ratio and oscillograph deflection sensitivity.
6. Measurement of voltage amplitude and wave shape across test specimen by calibration of oscillograph deflection directly against the sphere spark gap.

All the laboratories which submitted data used either one or some combination of more than one of these methods of measurement and check.

The close agreement between the data submitted by the several groups makes for confidence in the results obtained by each group in spite of the differing methods.

Seven papers on insulators were presented by title and created considerable discussion. As stated by J. B. Whitehead, the insulator problem is largely one of mechanical design, but there may be an association of internal electrical discharges and mechanical failures. Electrical losses, however, have little to do with the problem. C. F. Harding stated that much remained to be done in insulator testing with impulse flashovers under humid conditions. He also suggested vibration tests as necessary.

W. A. Hillebrand stated that cap and pin insulator designs had been made for several types and that the evaluation of their relative advantages must await a

longer service life. The critical element on all designs is the stresses in the porcelain and the longest life insulators must have low levels of thermal and mechanical stress. The small leeway given designers to handle these stresses made the problem difficult. He recommended the use of the A.S.T.M. test for porosity as the best available and stated that the static time test is not the most important when compared to the cyclic thermal stress tests. He stated that the new metal-coated cap insulator described should be considered closely under wet or contaminated atmospheric conditions, since all data were given for dry tests. He also suggested the use of a conducting paint rather than an asphalt compound for field maintenance of this type of insulator because he believed the asphalt would carbonize and cause trouble.

C. L. Dawes stated that research work in loss and power factor measurements were under way at Harvard. Power factor values vary with the magnitude of the voltage and are variable even with a constant voltage. Power factor and watt loss are found to vary with the stresses placed upon insulators.

K. B. McEachron stated that more work must be done in temperature, pressure and humidity effects upon insulators. R. L. Sorenson said life tests on insulators were under way in California and that preliminary data suggested changes in test specifications.

K. A. Hawley said several laboratory variables remained to be studied on insulator design and test. The porcelain itself expands or contracts under tests.

W. A. Kates pointed out that in testing a large number of "Pyrex" insulators it was found that electrical failure was merely an indication of initial mechanical failure, and this may also be true of porcelain insulators. He pointed out that insulators of the non-cemented type were available, although not described in the papers. He suggested that test results be given in terms of pounds per insulator and in addition pounds per square inch of bearing surface or pounds per cubic inch of volume.

Automatic Station Devices Being Extended

IN THE session under the auspices of the automatic stations committee the discussion focused largely on the thermal converter scheme of totalizing and the relative status of electronic and mechanical types of voltage regulators. Referring to F. Zogbaum's paper on the former topic, M. E. Reagan emphasized the importance of line reliability in telemetering. R. C. Buell pointed to the inherent time delay of the thermal converter scheme, a characteristic which prevents giving the operator a clear indication of swinging loads, instability or sudden changes on load. The author felt that this was an advantage rather than a disadvantage in this particular New York installation because it gave a smoother index of the load trend and average level. Nor does New York Edison have protective relays, there being no fear of breakdown of the converter under short-circuit conditions. Both Mr. Zogbaum and H. C. Forbes answered Mr. Reagan's query about adding supervisory control and P. B. Juhnke's about having reverse indications by saying that this telemetering system is primarily for getting a forecast of the load immediately ahead so that delays from excessive telephone dispatching could be averted and station economy schedules improved thereby. E. J. Rutan said the system had a few troubles at the start, but these were eliminated promptly through frequent maintenance. This was weekly at the beginning and the ultimate schedule will call for monthly inspections.

Mr. Juhnke pointed out that this system was equally desirable for small systems. E. E. George said that telemetering in its ideal practical form would have to function on a telephone circuit through insulating transformers and without interference with simultaneous conversation or without undue susceptibility to inductive coupling.

Electronic voltage regulators

Transition from mechanical to electronic regulators is taking place and, in the opinion of G. W. Garman, may more and more supplant machine exciters within the range in which the excitation requirements of generators do not exceed tube capacities. A limited number of direct excitation type electronic voltage regulators is in service, the largest installation supplying and controlling the excitation of a 15,000-kva. synchronous condenser. The full load excitation is 560 amp. at 135 volts.

Mr. Garman, in describing the G.E. developments, emphasized the necessity of providing dampers in these electronic regulators to compensate for the inertia of the field circuit of the exciter. The method of doing this is somewhat different from that followed in the Westinghouse design as described in F. H. Gulliksen's paper. C. W. La Pierre pointed out that provision must also be made to eliminate the second harmonic output of the bridge which measures the voltage change to which the regulator responds. If tungsten lamps are used there is inherently a 120-cycle pulsation in filament resistance corresponding to each half wave of the 60-cycle current. This can be filtered out and, with proper care in selecting the lamps, precision of a few hundredths per cent in regulation by the electronic device is feasible. The G.E. regulator differs further from the Westinghouse design in that it adds the rectified voltages from all three phases; another point of difference is that the pilot battery is replaced by glow tubes.

Philip Sporn reported that the 15,000-kva. electronic regulator installation cited by Mr. Garman was frankly experimental when put in, but 35,000 hours of experience has shown it to be at least the equal of mechanical regulators. One of the "Thyratron" tubes gave a life of 17,800 hours, the average of all tubes being about 15,000 hours. The American Gas & Electric system has four of these electronic voltage regulators. E. E. George said reliability is imperative because one failure will vitiate the confidence of the operating staffs in them and make difficult a fair opportunity to take advantage of the more refined regulation afforded.

Automatic synchronizers need not take much cognizance of the rate at which systems change relative phase in synchronizing large systems because no difficulty is being experienced in pulling the systems together even when they are 50 degrees apart. This was the opinion expressed by E. E. George in comment on the paper by H. T. Seeley, and he added that code necessitation of five men to keep continuous attendance at one-man substations would, if it persisted, lead to more and more resort to automatic equipment of all types.

Radical Changes in Engineering

Organized Effort to Recognize and Act Upon the Change in the Status of the Engineer Takes Form in the E.C.P.D.

By C. F. HIRSHFELD
Chairman Engineers Council for Professional Development.

IT SEEMS to me quite reasonable to assume the engineers of this country are capable of forming and maintaining a comprehensive national organization which shall function for the engineering profession somewhat as does the American Medical Association for the medical profession. More than that, I firmly believe that such an organization must exist and must function effectively if the engineer and the engineering profession are to meet the demands of government, industry and, in fact, social and economic progress now and in the immediate and distant future. I am convinced that the coming generation of engineers will declare us to have been remiss if they do not find such an organization ready to their hands.

This is not theory. Most of you who are practicing engineers are so busy with your daily problems that you do not have time to mix with and obtain the views of those who will shortly replace you. It happens that for years I have been thrust into most intimate contact with such younger men. There has appeared recently a very marked change in their viewpoint with respect to such matters as I have been discussing. They are no longer satisfied to enter an unorganized profession, functioning only through a number of specialized national societies. *They insist that the profession shall be organized in such a way that it can function as a unit in those matters having to do with its social and economic problems.*

Start of Engineering Council

Undoubtedly you all know that there has been formed recently a joint body known as Engineers Council for Professional Development. It came into being as the result of a number of different aspirations and activities, all leading toward a common end, namely, the formation of a joint engineering body which could properly and effectively represent the engineering profession with respect to certain types of problems and activities.

There was, for example, the very insistent demand of the younger generation of engineers that I have already spoken of. Again there was a feeling on the part of certain far-sighted men connected with the state licensing of engineers to the effect that the engineering profession could and should co-operate in the formulation of criteria and methods to be used by those licensing boards. These men, themselves engineers of attainment and with high ideals for the engineering profession, feared a development in which the state licensing boards and the practicing engineers would travel their own individual ways heedless of the existence of common problems demanding joint action for the good of the profession and of the public.

A third driving force was the sudden realization by engineering educators of the significance of some of the powers that had been given state licensing boards. These boards, acting independently, were empowered to compile lists of accredited schools of engineering. Certain early attempts at such activities in the hands of some of the boards caused a few of our best-known engineering educators figuratively to gnash their teeth and tear

The Engineers Council for Professional Development has been established upon the co-operation of seven founder groups chosen to represent the educational, legal and professional aspects of engineering. A revolutionary concept for the bettering of the status of the engineer, it is already effecting tangible results. Every engineer should be thoroughly familiar with the philosophy behind the issue and its progress to date. Dr. Hirshfeld, long chief of the research department of the Detroit Edison Company and chairman of E.C.P.D., is well known to electrical industry men.

Abstract of paper presented at A.I.E.E. Convention, Hot Springs, Va., June 26.

their hair. In fact, the condition of one that I spoke to could be described best by saying that he was about ready to froth at the mouth. These educators suddenly realized the need for some authoritative national instrumentality which could obtain that effective co-operation between diverse bodies as is required for a proper solution of this problem.

Further, industry and the nation at large were recognizing more and more the need for the development of engineers who, while well trained technically, should also be more broadly educated so that they possessed knowledge and ability in other fields of human history and activity.

And, finally, certain engineers prominent in the affairs of our different engineering societies had become convinced that there existed a real need for a joint body of some sort capable of speaking for the engineering profession as a whole in matters having to do with the educational, legal and professional aspects of the engineer's life.

Basis of action

ALL these beliefs, aspirations, convictions and movements, with many others, finally headed up in the formation of E.C.P.D., a joint body set up by the following organizations: American Society of Civil Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers, American Institute of Chemical Engineers, Society for the Promotion of Engineering Education, and National Council of State Boards of Engineering Examiners. You will recognize the fact that the bodies are so chosen as to represent the educational, legal and professional.

This joint body consists of representatives named by the parent organizations. It has delegated powers only; that is, it is not authorized to do anything until so instructed by the parent bodies. It constitutes an instrumentality through which the engineering profession, considered in its broadest aspect, may become not only vocal but effective in action. For the first time in the history of this country it gives the engineering profession something about which it can unite. But please note very carefully that it does not take from any existing organization any powers that that organization previously had, and note further that it does not propose to attempt to do so.

The immediate program of E.C.P.D. is capable of comparatively simple statement. It consists of four main parts which naturally lead from one to the other. Briefly, these are:

(a) Proper selection and guidance of those who are to enter upon the study of engineering.

(b) Development and maintenance of proper and effective curricula in schools of engineering.

(c) Effective guidance in such post-graduate, personal education as is deemed necessary to produce a fully rounded engineer. Incidentally, provision is also made for the guidance and assistance of those who desire to study engineering without going to a recognized school of engineering.

(d) Co-operative agreement upon and enforcement of the degrees of achievement or accomplishment which should be attained by an individual as he mounts different rungs of the ladder leading to the status of a full-fledged engineer.

In spite of the simplicity of these statements, and of the essential simplicity of the aims themselves, the actual conduct of the program is fraught with great difficulties. By no means the least of these spring from the essentially individualistic characteristics of the engineer and of his existing institutions. He and his institutions give ready lip service to the program that these institutions have already approved in a general sense. But when we come to the consideration of the units of that program, they are not considered as part of a whole. They are considered in their effect upon some conventional thought process or some existing way of doing things. This is but human and is to be expected. But one might be sufficiently idealistic to hope that the engineer who prides himself on the recognition of fact and upon clear and impersonal thought could rise above such petty considerations and view matters of this sort in the light of the profession as a whole and of the advancement of the profession.

An example taken from the field of engineering education may serve to illustrate the sort of difficulty referred to. After lengthy and careful consideration, E.C.P.D. decided to recommend that it be authorized to prepare and maintain a list of accredited engineering schools. Note that this recommendation is made by duly accredited representatives from the professional engineering societies, from S.P.E.E. and from the national organization of state boards of engineering examiners, so that all parties in interest are represented. The recommendation indicates it to be the considered judgment of these individuals that such a centralized and representative body as the Engineers Council for Professional Development should accredit these schools.

Now what happens when this recommendation is received by the parent bodies whose favorable action is required before any active work can be undertaken? Do we find a universal recognition of facts as we should expect from engineers and the consideration of the subject in the light of those facts and in a broad way? By no means. We find a very human tendency to ignore the broader question and to concentrate upon the minutiæ of the suggestion. I admit it is quite human, but I also admit that I hoped for better from engineers. Possibly I am too great an idealist.

Listing of accredited schools

FACTS of the matter are these: State engineer licensing boards must prepare lists of accredited schools. The national organization of the members of these boards must prepare such a list. These men and the national society devoted to engineering education have said to the engineers of the country through E.C.P.D.: "Here is a task which merits the best judgment of all of us. We must have such lists. We would prefer that we arrive at them co-operatively. We invite your help." Would it not be most in the line of engineering thought and practice to recognize that we are to have such accrediting and that it will probably be done best if we co-operate in the doing?

I admit freely and frankly that nobody really knows the best method to use in accrediting engineering curricula. But I maintain that discussion of the method to be used properly comes after a decision regarding the major proposition. I admit that certain costs are involved, but I cannot see that this fact need preclude the approval of the general principle, subject to a later satisfactory solution of the problem of defraying those costs. To me the question is very simply this:

"If we must have accrediting, as is the case, do we as engineers recognize the desirability of national ac-

crediting by a most representative body, or shall we allow the matter to drift to the end that we shall have almost innumerable lists, differing widely among themselves and serving the individual purposes of small and disconnected bodies?" To me there appears but one answer. The engineer stands for organization properly set up and smoothly functioning. The alternative of favorable action in this case appears to be to lead to the worst kind of disorganization, or at least lack of organization.

I believe we may view the formation of E.C.P.D. as an almost spontaneous recognition of a radical change in the status of the engineering profession. Things of such great magnitude in human affairs have a peculiar way of working themselves out. Development occurs slowly but surely as a sort of subsurface phenomenon, unnoticed and frequently unsuspected. Eventually appear here and there the wavelets, and finally the waves which herald the activity. And finally comes the tidal wave that carries all before it. There can then be no doubt of the reality of the phenomenon in the minds of any.

Just a first step

IN ORGANIZING E.C.P.D. we have but taken very crudely the first step in preparing for the coming generation of engineers. The world is becoming conscious of the social and economic significances of engineering as never before. It is already demanding a greater responsibility on the part of the engineer for the changes that his works have brought about. And, in very plain language, it finds a dearth of engineers trained and experienced in such ways as to enable them to carry the responsibilities that the world desires to place upon their shoulders. In terms of the medical profession, we have arrived at the place where the witch doctor is replaced by the student of anatomy, pathology and drugs, but we have not yet reached the stage of public health officers and of public sanitation. We can handle individual engineering problems, but we are not prepared to accept our share of national responsibility in the further evolution of the social and economic structure that is being more and more influenced by our works.

Not a temporary condition

Please do not misunderstand me. I do not refer to the depression out of which we appear to be emerging. I have in mind a process which has been going on for several centuries and has been particularly active in the past half century. We still find lawyers, military men and so-called business men wrestling with problems that we engineers have created. Is this because these men are pre-eminently fitted for such tasks? I think not. They themselves frequently admit that they are not. To my mind they are required to carry a disproportionate share of the burden because the engineer has not hitherto deemed it necessary to prepare himself to share such burdens.

Remember that we are the individuals charged with the education and other preparation of the next generation of engineers. If we do not address ourselves consciously to this task and with a full realization of our own shortcomings, this next generation is going to find itself equally handicapped. I feel certain that in E.C.P.D. we have created an instrumentality which is capable of taking the first steps in the desired direction and I feel equally certain that it contains the potential power to develop for us a united engineering profession which knows approximately where it is headed and how it proposes to get there. I am not one who thinks that huge affairs can be planned in advance and completely controlled in progress as is now so commonly believed, possibly in desperation. But, as an engineer, I recognize that affairs which are of such small magnitude and are influenced by so few factors that they can be encompassed completely or nearly so by human mentality are much more apt to maintain an ordered and intelligent course if properly planned in advance and properly supervised later. I am satisfied that the development of an engineering profession as visualized by E.C.P.D. falls within such limits and is therefore properly a subject for proper planning and properly supervised development.

I do not believe that E.C.P.D. is the end and all. I do not believe the E.C.P.D. organization perfect or its program complete and flawless. All that I believe is that it is now a necessary instrumentality, that it possesses the required potentialities for achieving what I think most of us must recognize as imperatively necessary and that it is capable of functioning advantageously now while we are engaged in learning from experience where and how it and its program should be changed.

As an engineer who has been intimately associated with this new organization from its inception I bespeak of you its careful study from an engineering viewpoint, with the exclusion of all personal and petty considerations. I feel very certain that if you will act in this way you will become convinced that we have reached the place where we must have a comprehensive national organization, that E.C.P.D. represents a very reasonable starting point and that the governing bodies of its parent organizations can well afford to become and to remain thoroughly cognizant of its aims and activities. I am equally certain that if these governing boards can see their respective ways to the doing of this, there will be no essential difficulty placed in the way of carrying through this epoch-marking movement.

Institute Prize Papers—1933

National Best Paper Prizes

Engineering Practice

"The Principle of Condenser Discharge Applied to Central-Station Control Problems," by F. H. Gulliksen.

Theory and Research

"A New Method for Initiating the Cathode of an Arc," by Joseph Slepian and L. R. Ludwig.

National Prize for Initial Paper

"A New Method of Investigating Cable Deterioration and Its Application to Service-Aged Cable," by K. S. Wyatt, E. W. Spring and C. H. Fellows.

National Prize for Branch Paper

"A Universal Measuring Instrument for Communication Circuits," by T. B. Wagner.

Rational Education—Some Suggestions

What Should Be Done in Higher Education Better to Fit the Student for Managerial and Technical Activity in a World of Engineering?

By L. W. W. MORROW
Editor "Electrical World"

AN ANALYSIS of prevailing conditions and opinions in this country shows three new and quite distinct aspects, when studied from the point of view of engineering practice and engineering education. The first of these is the idealistic concept that future engineering contributions must advance the standard of living and benefit mankind in his social relations. The second is that a large part of industry has become mechanized and requires a large staff of operators and managers which is now unsatisfactorily supplied from engineering graduates. The third is that industry requires only a relatively few highly trained engineers to do its diverse yet specialized technical engineering and research work. Add to these market demands the great expansion in fundamental scientific and engineering knowledge made in recent years, together with the development of a high degree of specialization in each branch of industry and in each functional job in industry. This gives a perspective of the formidable and complicated problems now presented to engineers and to engineering educators.

A thorough analysis of the origin of the social concept of engineering and of the difficulties that confront the profession in endeavoring to carry it out leads to the conclusions that the concept is erroneous and that its practical application is impossible. It is analogous to the splendid generalization that poets should write only poems that contribute to man's well-being or to advocate that all medical practitioners must also be public health officials. But it is unsafe to use these idealistic generalizations when dealing with specialized fields of training and practice. Experience, not theory, has dictated specialization. The humanitarian ideal of engineering takes into account neither the function of the engineer nor the practical requirements of both his educational and professional activities. The engineer can build a bridge to withstand a definite stress, but he cannot protect his bridge from breakdown if human beings load it beyond its design limits. This is the functional job of the policeman.

Viewed accurately, the engineer is but one of hundreds of similarly specialized functional operators in this civilization. He can co-operate with other citizens to perform his broader obligations to humanity, but he cannot, in his specialized education and practice, devote concentrated attention to the social and moral aspects of life and weigh his work on these scales. He cannot succeed in his profession and at the same time carry on a Messianic rôle in civilization.

Abstract of paper presented at A.I.E.E. Convention, Hot Springs, Va., June 26.

Engineers as business men

But social ideals should not be dismissed from a less idealistic consideration, because undoubtedly there are practicable opportunities to introduce training for men who are not specialized functional engineers that will enable them to advance our standards of living. These opportunities lie in the possibility for training better equipped men to staff industry in those positions that do not require specialized or professional engineers as functional technical workers. With the growth of the use of power, engineering equipment and engineering methods and the coagulation of industry into business enterprises that consist of a large assembly of men, money, equipment and materials there has come about a demand for semi-technical men to operate, maintain and manage these enterprises. These men do not perform specialized

As a result of industry analysis, changes in the type of college instruction now given are proposed. According to Mr. Morrow, who has been an educator as well as editor and practicing engineer, the majority of students should be given a broad education which co-ordinates instruction in science, engineering, economics and psychology, so as to fit the graduate for the managerial and operating positions in industry, while a smaller group should be given specialized scientific and engineering instruction.

engineering functions, yet they use engineering knowledge in combination with other knowledge to do the required work. In all manufacture, in transportation, in communication, in light and power supply and in many other industries the operating staffs must be competent and trained men and it is very desirable that a large number of these men should have training in fundamental science and engineering as a part of their preparation for their duties.

These men are responsible for getting results from the aggregations of capital, labor, power and machinery that go to make up business enterprises and they must bring to bear a broad yet specialized knowledge of their work because they must use and weigh many engineering, social and economic values in making decisions or in conducting their parts of the business. They should know pure science, applied science, economics, banking, accounting and psychology in order to succeed. They are the cogs and controllers in the business mechanism. The requirements for their adequate training are as diverse as their functional tasks in business, but they do not conform to the definition or to the functional specification of the professional engineer. They may well be called professional business men.

Engineers as business men

OCCUPATIONAL records of engineering graduates during recent years show 60 to 70 per cent of them to be now engaged in this class of work. They start as testers, apprentices, helpers, clerks, maintenance men and operators and advance along various paths to become heads of departments and managers. They do not use their technical tools nor their technical knowledge in any direct specialized applications after graduation, even though many of them bear the title of engineer. Even the chief engineers of large enterprises are more nearly business men than engineers because they have not been able to keep up their technical proficiency during the lapse of years and have devoted their talents to management, with stress upon its economic and organization aspects.

At present this industrial market is supplied largely, but in hit-or-miss fashion, by the engineering schools. But this is only because these graduates approximate the specifications most closely. And an unfortunate feature of this situation is that the men are not properly trained and perform their work too frequently by over-stressing their engineering point of view and under-stressing the social and economic aspects of business. And even their technical competency should be challenged after the lapse of a few years. They have become rusty and out of date, but will not acknowledge this fact when technical matters are under consideration. A combination of pride in their former training, in their label of engineer and the egotism that accrues with position causes them to believe they are still competent technical engineers and that they can and should make technical decisions without consulting specialists. As a consequence many very bad engineering decisions have been made in all industry and millions of dollars have been wasted. This type of man cannot function as a business man as well as an engineer. As a corollary, undoubtedly these men, coming from engineering, are not adequately trained to perform the other duties required of their positions in industry. Possibly this is one reason for many present social and economic maladjustments—their decisions have been technical and not social in too many instances. Good engineers are seldom good managers of men; their training and their type of mind are against them in dealing with human beings.

The day of the specialist is here

Industry does not need and cannot use in strictly engineering functions the large number of engineering graduates produced each year by the technical schools. This fact must be faced by engineering educators. This decrease in the market demand for engineers has been accompanied by very greatly raised standards of proficiency in engineering training and a high degree of specialization in engineering practice. Specialists in dielectrics, in electronics, in thermodynamics and in many other lines of engineering have developed their branches to such a degree that a jargon as well as a knowledge prevails in each field that is not known by engineers in other fields.

Thus, in the technical realm, the field demand is for a thorough scientific and engineering training so that technical graduates may be equipped to start out in any of the numerous specialized fields of industry for which functional engineers are required. In this education, specialization must be discarded for a thorough but a broad general training in science and engineering because of time limitations.

The foregoing analysis indicates that the present demands from industry reduce to the possibilities of training two types of men: (1) A large number of men with a broad training that includes some fundamental engineering and science to fill the functional positions of a large part of industry, and (2) a small but very highly trained group of technical men who can be developed into technical specialists.

These two demands already have influenced engineering education directly and indirectly. One engineering educator says: "We are preparing men for life and not for professional engineering." Another says: "We are preparing men for professional engineering. We are raising our technical standards and are concentrating upon the use of rigid mathematical studies of the fundamental sciences. We are discarding all so-called practical and applied engineering courses." These two extremes are reflected in some degree in all engineering schools.

The ideal business course

Based upon the market for men, the type of training required, the advancement of society and the present competition, each engineering school can well afford to measure the possibilities for instituting a course that will prepare men for the business positions of industry. This course is broader than engineering and requires a new perspective, together with a university type of faculty and facilities.

Viewed from the standpoint of preparation for life in the present industrial civilization, the traditional arts course is more inadequate and more highly specialized than the engineering course. The mass of young men who graduate from engineering, arts, science departments and economic departments enter upon a business career. Yet none of these courses is balanced as to content, co-ordinated in teaching, or operated to give a preparation for a business life. Specializing in languages, literature or history is analogous to specializing

in civil or electrical engineering as a preparation for life. The specialization is a matter of direction only. From the point of view of industry and of this type of student there is an unbalance in course content and a lack of purpose and viewpoint in the teaching.

Why not make a new course that incorporates the best elements of both the engineering and arts courses to prepare the large majority of college students for business life and relegate both the older courses to more highly specialized types of education? This new course would prepare men for life as interpreted by the occupational positions of industry and commerce. The base of such a course would be science, applied science, economics and psychology, with electives in the humanities, in accounting, in banking and in business law. Such a course should be taught by teachers who have been trained in the use of scientific methods so common to engineering, who are familiar with the equipment and operations of industry and who are broad enough to introduce and use humanitarian criteria in their educational measurements of value.

Difficulties in combination courses

EVIDENTLY the present courses in administrative or industrial engineering do not measure up to the requirements and possibilities of the proposed course, although they attempt to do this in some degree. These courses are unsatisfactory because present faculties in engineering and arts are like water and oil. They do not mix. In some instances the economics department dominates and in others the engineering department keeps control. There is a lack of unity, perspective and co-ordination in developing and teaching these courses. The engineering instructors attempt to teach orthodox engineering as taught to technical students and use the technical point of view in teaching and then the economics instructors teach orthodox economics as given to arts students who specialize in the subject and use the academic point of view in their teaching. The usual result is either failure or a dominance by one department.

The course proposed would find its chief present handicap in finding competent teachers—with knowledge, with point of view and with courage to enter upon uncharted courses. Essentially the base for the student body, the faculty and the course content must come from the engineering and economics departments, with accent on the engineering method and point of view. The course must be a welded whole and not a composite of courses already given in the two departments. It must have a content, a method, an administration and an identity of its own to be successful. It should be a separate college in the typical university organization.

The ideal technical course

An equally radical approach to technical engineering education is indicated if the schools wish to supply the elevated technical demands of industry. The number of engineering students must be reduced more than 50 per cent and the courses must be changed in content and raised greatly in their technical standards. Extreme specialization in either theory or practice is impracticable in engineering education and thus students must be trained to enter upon a career in any technical field. Only fundamental scientific and technical subjects can or should be taught. Since recorded knowledge in science and engineering is now so voluminous, all instructional time must be devoted to the intellectual advancement of the student and this necessitates the elimination of routine, practice or informational courses.

Rigid treatment by the use of mathematics must be applied to the fundamental sciences to form the foundation for such a training and the course must be taught with a method and from a point of view that will develop initiative and adaptability for creative intellectual effort if it is to be successful. Undoubtedly the present engineering courses should be scrutinized closely and changed to conform to the new requirements and standards. Routine drawing and lettering, shop work to develop manual dexterity, laboratory work of the ordinary routine testing type, applied courses such as bridges, power, transportation, and even the present differentiation between civil, electrical, mechanical and chemical engineering courses—all these must be weighed, changed or discarded. In addition it might be advisable to weld together the pure science courses and the engineering courses to form one college in the typical university organization.

It should not be forgotten that an engineer is more than a pure scientist; he must be able to apply his knowledge to get practical results. Some degree of technique and manual dexerity is desirable and should be taught, but this element should be an incidental contribution obtained indirectly from the more fundamental intellectual training. It must also be granted that less rather than more time can be devoted to non-technical subjects, however desirable they may be. Perhaps an adaptation and concentration of the non-technical subjects are also feasible, so that the time spent on these courses will produce better results than are had at present.

An essential part of this conception of a technical course is a careful selection of the students and the instructors. They must be high in quality, although relatively few in numbers, and their capacities must be measured by technical yardsticks. Undoubtedly the student selective process should be introduced in his preparatory schools.

Conclusion

IF ENGINEERING educators agree to follow the demands of industry, the specifications for the two types of courses to give are as follows:

Course No. 1—A course for the mass of students that is based upon a broad education developed largely from science, engineering and economics and taught chiefly by teachers using engineering methods and having both business and engineering knowledge, so as to train men to staff and operate mechanized industry.

Course No. 2—A course with very high standards in science and engineering to be taught by scientific and engineering specialists to be given a selected number of students so as to train men to supply the specialized technical needs of industry—the future professional engineers.

Undoubtedly some schools can and should develop both of these courses, but a large number of schools will find it wiser to offer only one of these courses. Since the demand for the greatest number of men is filled by course No. 1 and since only a small number of men are needed by industry from course No. 2 the indications are that a majority decision will favor course No. 1.

It is apparent that most schools could not readily adapt themselves to the specifications for course No. 2.

To be successful in completely meeting industry demands, it would be necessary to make a complete revision of the typical university organization and to form a separate college for course No. 1 and another college for course No. 2. This, of course, would involve a radical change of the present university organizations and would require recombination of the existing colleges and courses.

New England Lightning Checks African Studies

Several months ago Dr. B. F. J. Schonland of South Africa reported upon lightning discharge studies made with the aid of a high-speed camera. The existence of a "leader" flash of high speed preceding the main discharge was reported.

By K. B. McEACHRON

Engineer in Charge, High-Voltage Research Laboratory, General Electric Company, Pittsfield, Mass.

On the evening of June 2 in Pittsfield, Mass., W. L. Lloyd and W. A. McMorris, members of our high-voltage engineering laboratory staff, were successful in obtaining some very good records of lightning discharges using a Boys camera of somewhat different design than that used by Dr. B. F. J. Schonland in his recently published work in South Africa.

During the June 2 storm, which was unusually severe in Pittsfield, ten separate strokes to ground were recorded. One of these was a multiple flash having ten recurrent discharges passing over the same path. All but one of the nine other strokes were too weak to leave satisfactory records for measurement.

The multiple stroke is of particular interest, showing characteristics similar to those described by Dr. Schonland.† Only the initial discharge showed any streamers, the others following the main channel only. Six of the discharges following the initial discharge showed the leader stroke progressing from the cloud to the earth very plainly. One of these is reproduced in an accompanying illustration showing the effect of the motion of the film in opposite directions. The trailing illumination following the main flash indicates that the path of the main flash existed as a source of illumination over its entire length for an appreciable length of time, of the order of 500 microseconds in some cases.

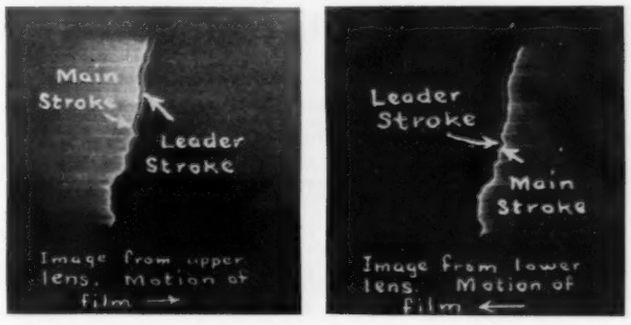
Only very slight illumination follows the leader strokes, indicating that the leader must have existed in the form of a dart, having a length which may be approximated from measurements of the width of the leader stroke. Preliminary measurements indicate the velocity of the leader strokes to be from 14 to 38 ft. per microsecond, while the illumination of the main stroke spreads upward from the earth at a velocity varying from 73 to 180 ft. per microsecond. These results are to be compared with 4.3 to 105 ft. per microsecond found by Dr. Schonland for leader strokes and 79 to 360 ft. per microsecond for the main stroke.

Three of the successive strokes did not show the leader either because of its absence or because it was too weak to make any photographic impression. The initial stroke, although showing the streamers, did not show a leader similar to those observed on the majority of the succeeding multiple strokes.

Another stroke, which was not multiple in character, was sufficiently well reproduced for measurement. Like the initial discharge of the multiple stroke, the usual leader stroke was not observable. This seems to indicate that only the multiple strokes will have leaders. A

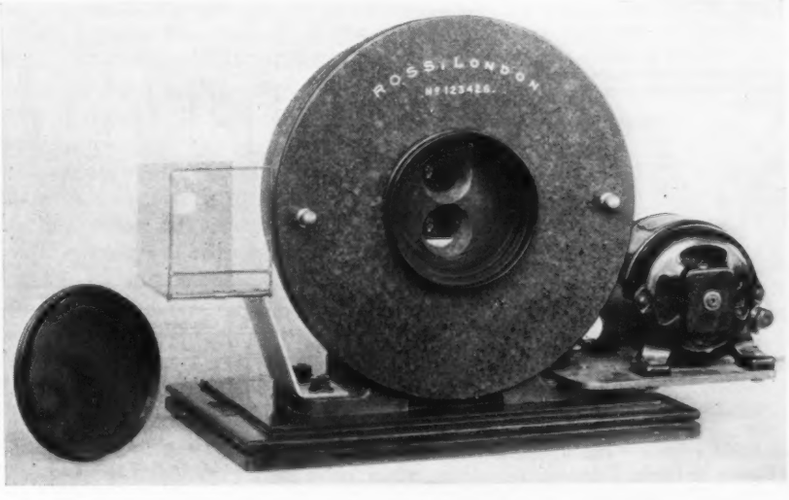
ELECTRICAL WORLD, *March 31, page 490, and May 5, page 666.*

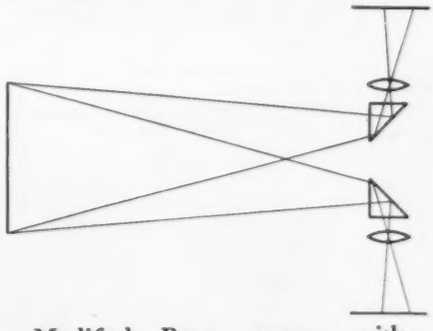
†*"Progressive Lightning," Dr. B. F. J. Schonland and H. Collens, Proceedings of the Royal Society, A, Volume 143, page 654, 1934.*


Main Stroke
Leader Stroke
Image from upper lens. Motion of film →
Leader Stroke
Main Stroke
Image from lower lens. Motion of film ←

"Leader" strokes precede main lightning discharges

Relatively low luminosity but high speed characterizes leader stroke discharge.





Modified Boys camera, with which Pittsfield studies were made

Duplicate exposures upon a single strip of film, but with opposite direction of film motion, are obtained with the use of matched lenses and prisms. The film moves at high speed.

minute examination of the leader and main strokes of a multiple flash show that the main flash follows the path of the leader stroke in general, but deviates from this path in detail.

These studies are being continued in Pittsfield, and subsequent storms should yield further interesting data concerning the mechanism of the lightning discharge.

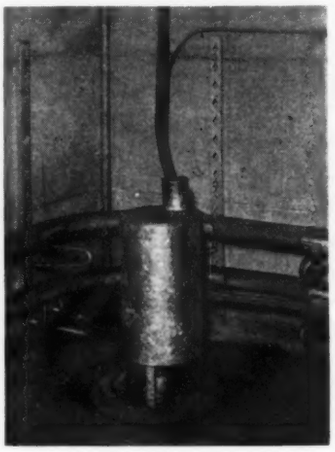
With this camera the film is placed on the inside of a rotating drum with the emulsion side toward the axis of the drum. Associated with the drum are two matched lenses with prisms so arranged that the images from the lenses appear simultaneously on opposite sides of the rotating drum.

As the direction of motion is reversed on opposite sides of the rotating drum, the time element in a direct stroke of lightning will move the image of the stroke progressively to the left on one side of the drum and to the right on the other side of the drum. Thus the two pictures, one taken with each lens, would be parallel to each other except for the motion of the film. Half of the separation at one end of the stroke will be a measure of the time taken to complete the travel of the stroke when the length of the stroke and velocity of the film are known. The velocity of the film is measured and the distance to the stroke determined by the sound or by knowing where the stroke terminated. From the focal length of the lens and the size of the image the length of the stroke is determined approximately.

With the camera used in making the records reproduced here, shown schematically in the accompanying illustration, the drum could be rotated at a speed of 3,000 r.p.m.

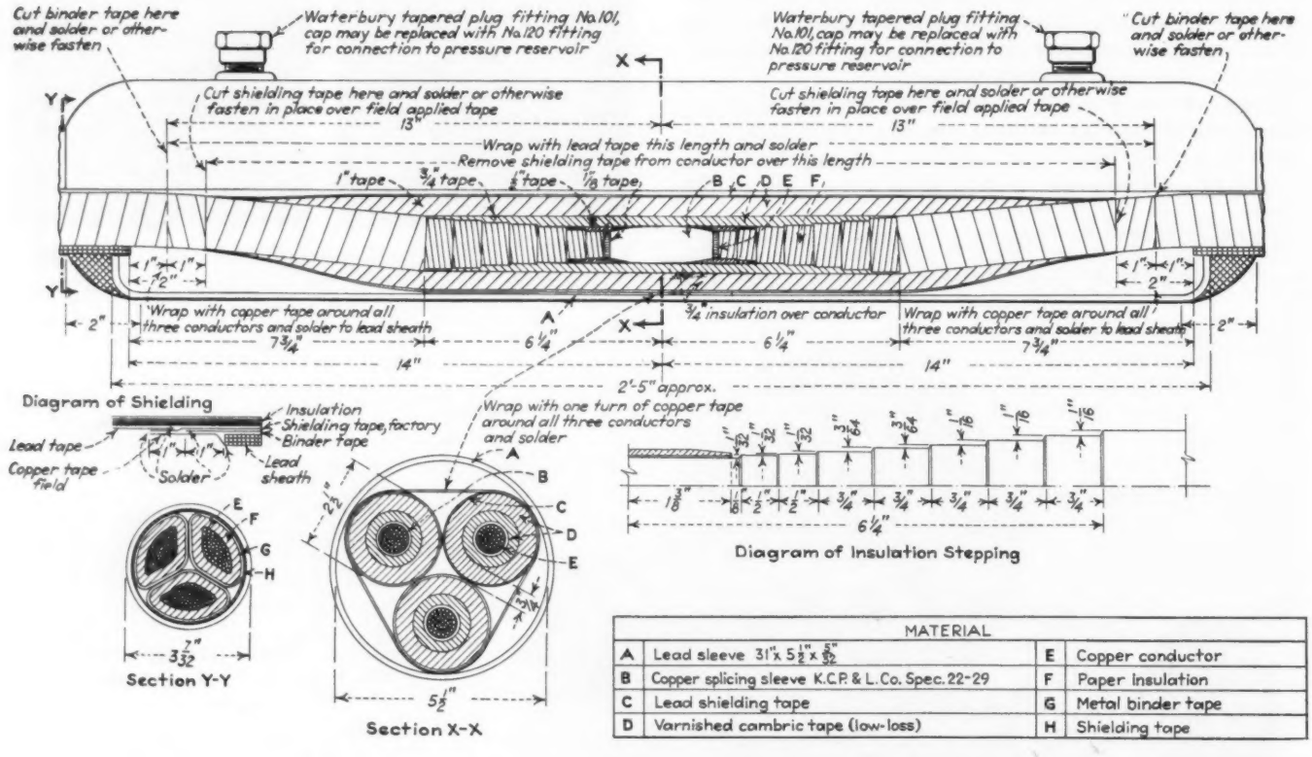
POWER COMPANY

Diving Bell Protects Sump-Pump Motors



In underground transformer vaults of the Commonwealth Edison Company, Chicago, water is a frequent visitor. Lake Michigan, with its continuous ground water pressure through the generally sandy soil underlying the city, is the chief cause. Therefore dry vaults are less common than wet ones and automatic sump pumps become an almost invariable feature. To protect the pump motors from rising water each one is sheltered under a sort of diving bell made of galvanized sheet as shown in the accompanying illustration. This form of air lock effectively protects the motor without attention.

A Splice for 33-Kv., Three-Conductor Cable


Cut binder tape here and solder or otherwise fasten
Waterbury tapered plug fitting No.101, cap may be replaced with No.120 fitting for connection to pressure reservoir
Waterbury tapered plug fitting No.101, cap may be replaced with No.120 fitting for connection to pressure reservoir
Cut binder tape here and solder or otherwise fasten
Cut shielding tape here and solder or otherwise fasten in place over field applied tape
Cut shielding tape here and solder or otherwise fasten in place over field applied tape
13"
13"
Wrap with lead tape this length and solder
Remove shielding tape from conductor over this length
1" tape
3/4" tape
1/2" tape
1/8" tape
B C D E F
1" 1" 1/2"
1" 1" 2"
2"
Wrap with copper tape around all three conductors and solder to lead sheath
3/4" insulation over conductor
Wrap with copper tape around all three conductors and solder to lead sheath
2"
7 3/4"
6 1/4"
6 1/4"
7 3/4"
14"
14"
2'-5" approx.
Diagram of Shielding
Insulation
Shielding tape, factory
Binder tape
Lead tape
Copper tape field
1" 1" 1"
Solder
Lead sheath
Wrap with one turn of copper tape around all three conductors and solder
A
B
C
D
E
2 1/2"
1 3/4"
E
F
G
H
3 7/32"
Section Y-Y
5 1/2"
Section X-X
1/32" 2/32" 1/32" 3/64" 1/16" 1/16" 1/16" 1/16"
1 3/8" 1/8" 1/2" 1/2" 3/4" 3/4" 3/4" 3/4" 3/4"
6 1/4"
Diagram of Insulation Stepping

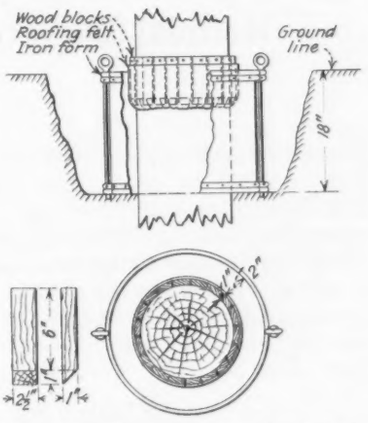
MATERIAL			
A	Lead sleeve 31" x 5 1/2" x 5/32"	E	Copper conductor
B	Copper splicing sleeve K.C.P. & L. Co. Spec. 22-29	F	Paper insulation
C	Lead shielding tape	G	Metal binder tape
D	Varnished cambric tape (low-loss)	H	Shielding tape

Many opinions are had about cable splices. The above illustration shows the practice of the Kansas City Power & Light Company in splicing 33-kv. cable.

ENGINEERING PRACTICE

Continuous Pole Impregnation Extends Life From 10 to 15 Years

Standing poles have been treated with satisfactory results for the past ten years on the Toronto Hydro-Electric System by a continuous creosote impregnation system. The method used consists of casting concrete sleeves around each pole, leaving a groove around the pole at the top for the impregnating mixture. The sleeves extend from the ground level to a depth of 18 in. with the annular space at the top 1 in. wide and 6 or 7 in. deep. This is filled with a mixture of pea gravel, sand and creosote and sealed with 1 in. of coal-tar pitch.



Forms used at Toronto for building concrete sleeves around standing poles

Sleeves are made by the use of the forms illustrated at a cost of approximately $6 when poles are set in pavement and $4 when set in unpaved places. The grooves are refilled at intervals of three or four years by breaking the seal in two places and pumping fresh creosote through one of them, after which the pitch is resealed. In the last three years 22,000 refills have been made at an average cost of 60 cents. Experience has shown that this relatively cheap method has extended the pole life from ten to possibly fifteen years.

Transformer Oils Dried at Room Temperature

High insulating qualities of dry transformer or switch oils are rapidly lowered when the oil absorbs moisture. It has been customary to recondition wet oil by subjecting it to a temperature slightly above the boiling point of water. To accelerate this process and to lower at the same time the required temperature this drying was sometimes accomplished under a slight vacuum. However, experience has indicated that even in this case a carbonization of very small particles of oil took place, which in turn was responsible for a premature aging and sludging of so treated oils.

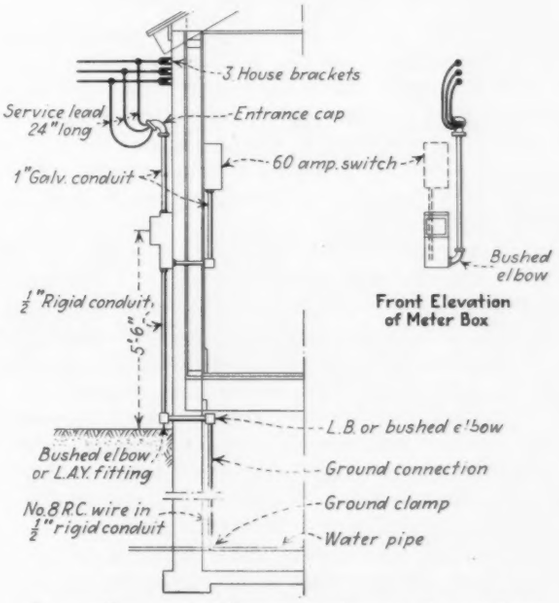
A large German concern introduced a few years ago a new (now patented) oil-drying method, said to yield perfect results in every respect, but which requires no heating of the oil at all. *(A.E.G. Mitteilungen.)*

The principle of the method is to spray the wet oil through a fine nozzle into a barrel in which a high vacuum of 90 to 95 per cent is maintained. At that vacuum water is given off readily from the atomized spray of oil. Practical arrangement of this method consists of two steel barrels connected with two pipes, each of them ending in a spray nozzle in each barrel. A small motor-operated vacuum pump can be connected with one or the other barrel. The wet oil is filled in one barrel and is gradually sprayed into the other barrel. The oil is thus transposed repeatedly from one barrel into the other. After doing this for about two hours tests will indicate that the oil is as good as new. Puncture strength of up to 250 kv. per centimeter can readily be obtained on good grades of transformer oils.

Inside Ground for Outside Meter With Wiring Knob and Tube

When installing an outdoor meter box on a residence having knob-and-tube wiring with no ground it is regular practice to make both system and equipment ground at the meter box. Southern Public Utilities Company requires No. 8 copper conductor for the ground. It was originally required that this ground be protected by rigid conduit, but due to changes in the electrical code permission is now given for the use of No. 8 bare ground wire cable or No. 4 bare copper. If no water piping system is available two driven grounds at least 6 ft. apart may be used for attaching system and equipment grounds, in which case the point of contact with the driven ground must be entirely covered. Where there are two additional grounds on the same secondary system only one driven ground is required.

When installing outdoor meter boxes on a house that has no ground on its electrical circuits it is permissible to ground the neutral conductors in the house at the entrance switch and to ground the equipment outside the building provided that all conduit in the box is properly bonded.



Grounding to inside water pipe at the outdoor meter box

New Channel Bus Design

By W. B. MORTON,
Senior Project Engineer,
Philadelphia Electric Company

and H. L. UNLAND,
Electrical Engineer,
United Engineers & Constructors, Inc.

More Than Tripling the Planned Additional Radical Departures in Bus to

INSTALLATION of a 165,000-kw. turbo-generator at Richmond station of the Philadelphia Electric Company in space provided for a 50,000-kw. unit necessitated the development of a new type of bus conductor and the working out of measures for the protection of adjacent steel from the heating effects of heavy currents. The dearth of available knowledge and experience in these unexplored fields forced an intensive program of investigation, including both field and laboratory tests.*

At the time the station was built, in 1925, two 50,000-kw. units were installed with 2,600-ampere main leads, consisting of three 5 x $\frac{1}{4}$-in. bars leading to the main bus in a vertical isolated phase switch house. The main bus, with a maximum rating of 4,000 amp., was formed of 4 x $\frac{1}{4}$-in. bars tapering from seven at the center to three at the ends. Generator lead runs were carried in concrete inclosures integral with the building structure. The main bus was inclosed in a composite housing of Alberene stone, asbestos lumber and steel. Maximum inside dimensions of these inclosures were 24 x 24 in. and in several locations where the lead runs cross structual steel members material constriction occurred. Space was provided in the initial building and lead run inclosures were built for two future 50,000-kw. units.

Tripled capacity created problems

The generator of the new unit now being installed is a double-winding machine, each winding being provided with a separate set of lead connections to the bus. To accommodate the two sets of leads from this generator it was found necessary to use portions of the lead run compartments initially provided for the expected 50,000-kw. units. The currents in these runs under conditions of permissible unbalanced loading are thereby increased from a maximum of approximately 2,600 amp., anticipated in the original design, to approximately 4,500 amp. In sections of the main bus the maximum current is correspondingly increased from 4,000 to 7,000 amp. These new current requirements made impossible the continued use of flat bar construction because of the decrease in value of additional bars above five, which approaches zero for eight or ten bars. Therefore a complete departure from this type of bus construction was necessary to obtain a conductor which would carry these greatly increased currents and occupy minimum space.

Use of cables was impracticable because of lack of sufficient space below grade to accommodate ducts and manholes. Neither aluminum shapes nor tubular conductors could be used because of space limitations in the existing compartments and runways. The hollow square bus built up of flat copper bars has been used to advantage for large currents where skin effect becomes a serious problem. However, this design, involving complicated clamps required for securing the assembly and for providing taps, could not be used in the restricted inclosures.

Split hollow bus selected

As a result of these studies, it was decided to use copper conductors formed in a modified channel shape, two such conductors forming a hollow square with $\frac{5}{8}$-in. separation between the two members, permitting cooling air to pass over the inner surfaces. Previous investigations† by others had indicated an optimum conductor thickness of approximately $\frac{1}{2}$ in. and for currents up to 5,000 amp. the hollow square formed by the conductor was chosen at 6 in. and for currents from 5,000 to 7,000 amp. a hollow square of 8 in. outside dimensions was selected. The manufacturer's rating of current-carrying capacity was verified by laboratory tests.

Cables and flat bars were found unfeasible for the 4,000 to 7,000 amp. established in double-winding 165,000-kw. generator leads and bus at Richmond station. Adoption of rigid hollow bus necessitated wholly new technique as to pre-fabrication, mounting and tap connections. Amortisseur grid and short-circuit loops about steel work also installed. When full revival promotes more rehabilitation these problems may well arise in many other stations.

A hollow square bus of this size is extremely rigid as a beam, as a column and against torsion. The forcing of alignment in erection is out of the question, so that limitations of straightness and twist in the members had to be established for the material at the fabricating plant. Established standards of the steel and non-ferrous industries do not cover this requirement, so that the specified limits were determined by an economic balance between the increased erection costs and increased manufacturing costs. Since these requirements are ignored in the metal industries, the methods of gaging that are

*"*A 7,000-Ampere Station Bus," H. L. Unland, W. B. Morton, V. R. Bacon, "Electrical Engineering," June, 1934.*

†"*Current-Carrying Capacity of Hollow Conductors," H. W. Papst, "Electric Journal," 1931, page 411.*

Solves Station Limitations

Generating Capacity Necessitated Handle the New Output

used in the lumber industry were adopted for testing the product.

In producing channels of the desired shape and size the manufacturer, the Anaconda Wire & Cable Co., encountered serious obstacles and after an extended period of experimentation developed a successful procedure. Carefully sized plates were first bent to approximate the desired form and were then drawn through dies to the finished shape and dimensions. The channels were then straightened by hand in the mill to bring the cumulative twist and bending within the specified limits. They were then matched in pairs and shipped clamped together, carefully supported in the railroad cars. Great care was exercised in handling the finished product to avoid damage to the copper.

Expansion met by special joints

In the case of a multiple flat bar conductor expansion of the copper, if restrained, will in most cases merely cause bowing of the bars without excessive forces on the bus supports. Expansion of the copper channel conductor, however small in magnitude, must be relieved by expansion joints. In the main bus these expansion joints were spaced as closely as 20 ft., to minimize movement of taps, with consequent torsional stress in the bus supports. One fixed point is located between each set of expansion joints to control the movement of the bus and to eliminate creeping of the bus as a whole.

A considerable problem was presented by the design of a suitable clamp and support for this type of bus, which would maintain the members in the proper relation and which would have adequate strength and rigidity under short-circuit conditions, as well as freedom to

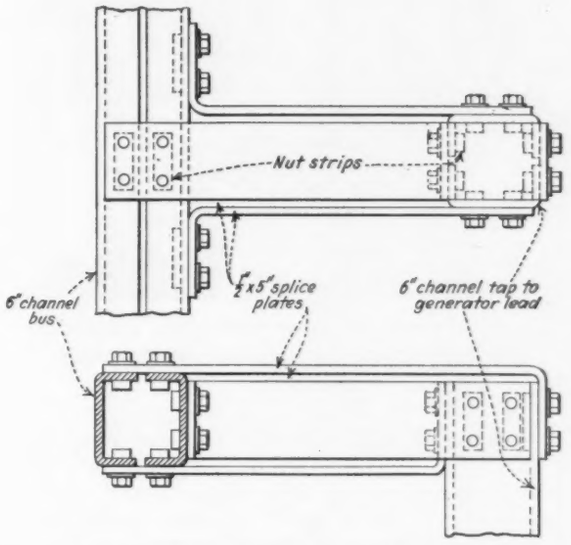


Fig. 1—Offset channel tap to channel bus

Contact surfaces of the channels at joints were machined to remove any slight irregularities. All this preparation was completed prior to erection. Rigid splice connections are made with ½x5-in. copper plates on all four sides of the assembly, with four ⅝-in. cap screws on each bolting surface to provide ample pressure. The fabrication of offsets and channel taps in the main bus resulted in some complicated bolting arrangements.

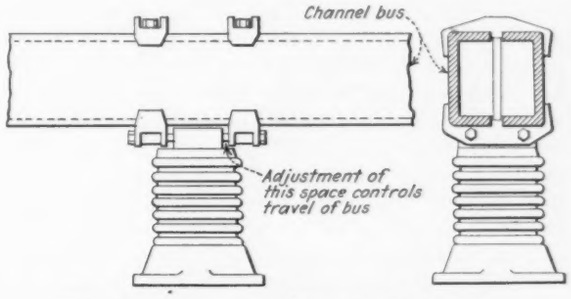
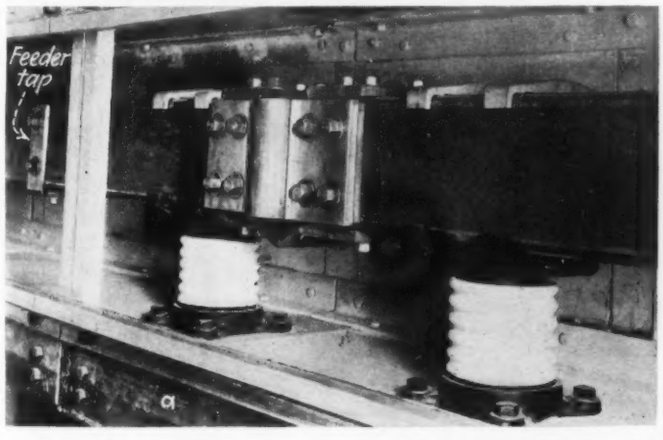
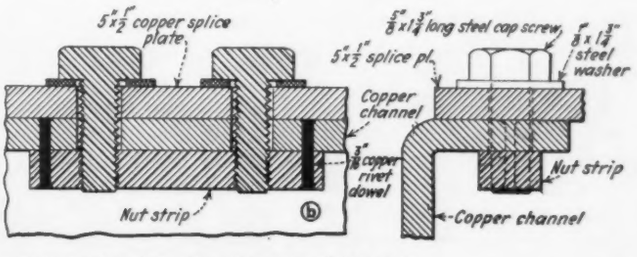


Fig. 2—Clamp assembly permits freedom of expansion movement





(a) Feeder tap also showing at the left.

(b) Steel washers ¼-in. thick and 1¾-in. diameter were used under the head of the cap screws, which were extra large in order to keep the pressure on the copper below the point at which cold flow would occur. Lockwashers are not used, as adequate tension in the bolts will prevent their backing out. The bolts were tightened with a pull of 40 to 50 lb. on the end of a 23½-in. wrench, or from 925 to 1,175 in.-lb. moment. This is somewhat higher than customary, but is required to secure locking tension in the bolt.

Fig. 3—Flexibility provided in expansion joint

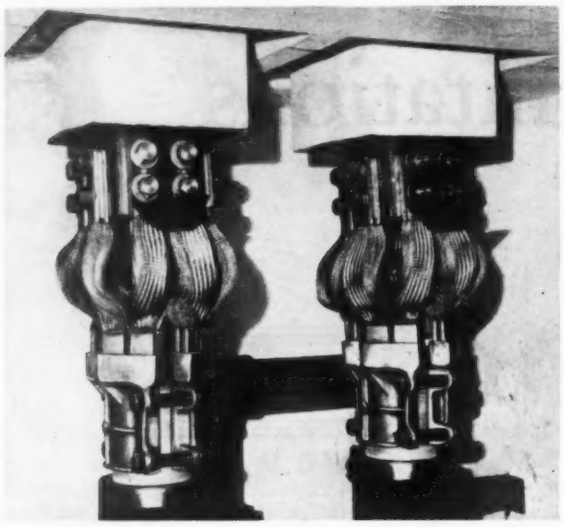


Fig. 4—Connection from 5,000-amp. oil circuit breaker to channel conductor made flexible

permit movement along the conductor due to expansion and contraction. A variety of designs were investigated involving rollers, springs, link supports and other mechanical features, while others involved drilling of the conductors, complicating the fabrication of the bus. The clamp assembly shown in Fig. 2 was finally developed to meet the requirements after tests to determine the freedom of movement under adverse conditions of alignment and the possibility of objectionable hum from vibration.

Nut strips used for connections

This assembly avoids drilling of the copper channels by utilizing the opening between the two members for the passage of $\frac{1}{2}$-in. clamping bolts, which hold specially shaped clamping and spacing blocks on the top and bottom of the channels, maintaining the two members in their proper relation. Longitudinal $\frac{5}{8}$-in. bolts through the lower clamping members slide in clearance holes in the bus support heads and permit up to $\frac{5}{8}$-in. longitudinal movement of the bus as a whole. Fixed points in the bus are obtained by adjustment of the longitudinal bolts to bring the lower clamping blocks to bear directly on the two sides of the bus support head.

Bronze is used for practically all the clamps and head castings of the bus supports, since machining of the bronze castings is unnecessary. However, iron parts will not develop excessive heating with conductors carrying currents up to 7,000 amp.

A method for the making of splices and taps to the copper channel conductor had to be developed. The inaccessibility of the inside surface of the hollow conductor precluded the use of the conventional through-bolt-and-nut construction. Nut strips of machine steel, tapped for $\frac{5}{8}$-in. cap screws and riveted to the inside of the conductors with clearance holes through the copper, permitted the bolting of joint plates or tap connections to the copper channels (see Fig. 3).

Connections to disconnecting switches involved special terminal blocks on the switches, to which the channels were connected by splice plates. Liberally designed flexible leads were used in the connections to oil circuit breakers to avoid any force on the breaker bushings (Fig. 4). Smoke barriers were installed where the bus passed through section fire walls (Fig. 5).

In the course of the academic investigation of conductor capacity it was determined that dangerous heating would occur in steel members in the vicinity of conductors carrying currents of the magnitudes considered, due to the space limitations of existing construction. This introduced a new series of problems, beginning with a determination of the maximum permissible temperature and including the development of measures to keep steel temperatures below that limit. Field and laboratory tests were carried out to obtain the solution.

This heating arises from two causes: First, from circulating currents in circuits forming a loop unsymmetrical with the conductor; second, from hysteresis and eddy currents due to concentrations of magnetic flux. The heating in every case is greater for single-phase conductors at an appreciable distance from the return source than for three-phase conductors adjacent to each other. The universal preventive of all types of inductive heating is, of course, adequate spacing.

It was determined in the investigation that heating resulting from circulating currents may be reduced by either of two methods: First, by making certain that no loop circuits exist; second, by introducing neutralizing fields produced by properly located and designed conductors in which current is permitted to flow, being induced by the magnetic field of the main conductor. These secondary conductors lie between the main conductor and the protected material and parallel to the main conductors, and they are connected together at the ends of the run, acting in the same manner as an amortisseur winding on a motor. This device is here referred to as an "amortisseur grid" (Fig. 6).

The entire grid is carefully insulated from ground except for a single point of connection to the ground system in order to eliminate the possibility of additional heating by induced circulating currents.

An example of this type of heating was observed during a 5,000-amp. test heat run on the completed generator lead conductors when certain points of connection in the inclosure framing were heated to incandescence by the induced circulating currents. Since the amortisseur grid does not protect against heating in steel on the opposite side of the bus, which was the framing for

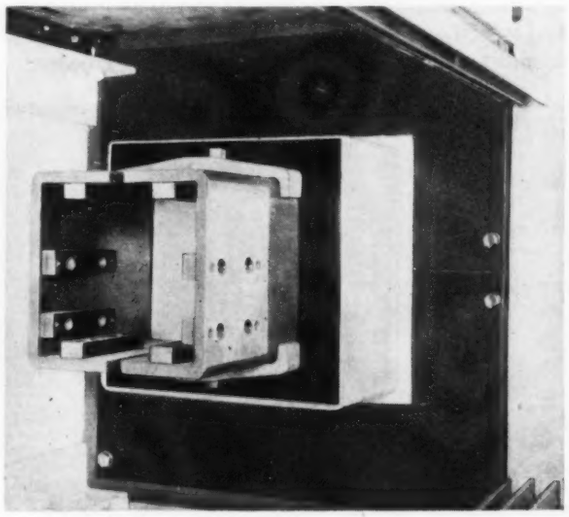


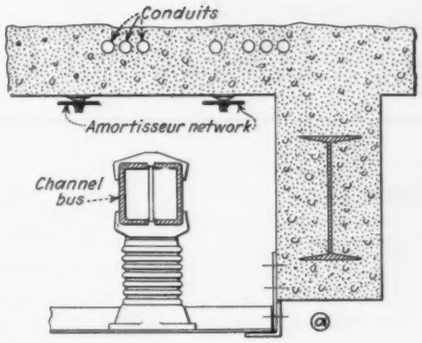
Fig. 5—Smoke barriers installed in fire walls

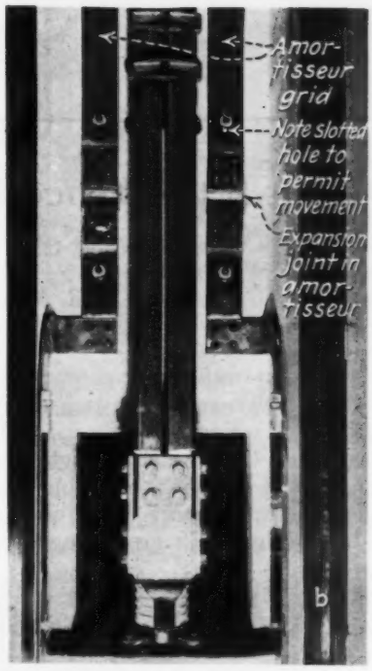
the compartment doors, it was necessary to sectionalize carefully all inclosure framing and to provide only a single connection to ground from each section. This eliminates undesirable loops through the ground system which occur where more than one connection exists.

Short-circuit band around steel

Heating due to flux concentrations may be controlled only by setting up neutralizing magnetic fields. These may be provided either by amortisseur grids or by short-circuited copper bands properly placed around the steel member involved. Where heating was induced in steel members crossing single-phase conductors a band of copper (Fig. 8) when placed around the steel member at the point nearest the conductor was found to be most effective in reducing the temperature in the steel. The temperature rise in the steel member was found to be greatly affected by the position of the band, but only to a minor extent by the copper section of the band; on the other hand, the heating in the band itself was materially affected by its cross-section. The currents induced in these copper bands and amortisseur grids, while beneficial in reducing heating of the steel, do cause losses and the liberation of additional heat in the inclosures, which introduces another problem.

Because of the unsatisfactory heat-dissipating qualities of the existing concrete conductor inclosures, together with the additional losses contributed to the compartments by the protective bands and amortisseurs, it is expected that forced mechanical ventilation of the generator lead runs and main bus inclosures will be required. These losses, added to the heat liberated by the new generator and bus-sectionalizing reactors, in turn necessitated forced ventilation of the entire switch house. The paralleling of heavy current conductors by portions of the new ventilating ducts required that the entire duct system be insulated from ground except at a single point of connection to avoid possibility of induced circulating currents. The necessity for this precaution was demonstrated when one of the bolts in the duct-supporting structure accidentally made contact with the building steel and formed a loop which caused high temperature in the bolt and parts of the supporting structure.





(a) The amortisseur grids used consist of single 4x¼-in. bars where the three conductors were close together and two 4x¼-in. bars where the main conductors were separated on the several phase floors in the switch house. In that portion of the generator lead run where the three main conductors were close together the amortisseur grid not only protected the conduits and reinforcing and similar inaccessible members but was found to provide ample protection to beam crossings.

(b) Heating of the amortisseur bar introduced problems of caring for expansion, since buckling of this bar might dangerously reduce ground clearance. As in the case of the main conductors, expansion joints are installed at convenient points and slotted holes, with spring washers under the bolt head at the supports, provide for longitudinal movement.

Fig. 6—Amortisseur grid introduces neutralizing field

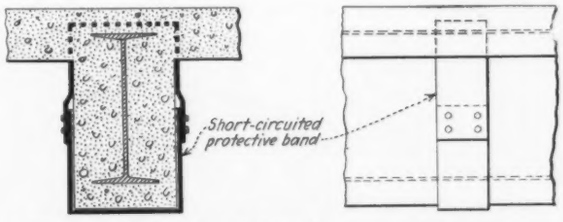


Fig. 7—Short-circuit bands stop eddy currents in steel

Heating effects in compartment doors were investigated for various types of construction and materials. Metal frame and metal-clad doors, in which both steel and non-ferrous metals were used, were tested in all probable positions relative to the conductors. It was found that heating would be produced in any door of metal construction unless the design is so special that the cost becomes prohibitive. Resulting from this investigation, the doors used were constructed entirely of asbestos lumber. These doors are extremely rigid and no warping has been observed in the doors that have been installed for a year. Ventilating louvers and screens in compartment doors are of aluminum construction.

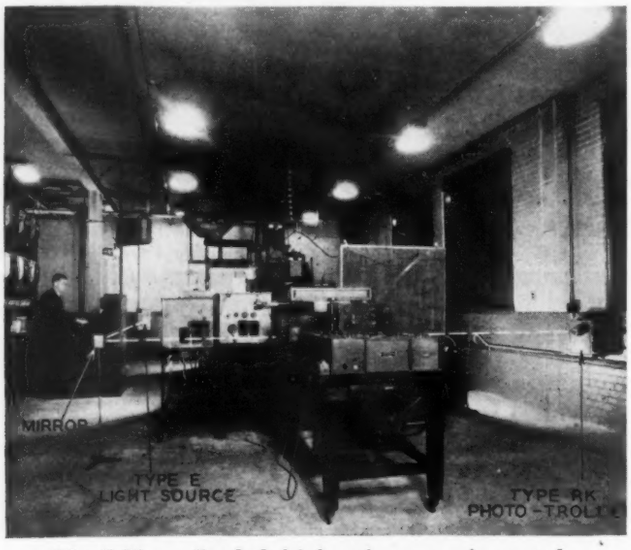
Since the large 1,875-kva. reactors in the generator lead runs and in the bus sectionalizing compartments would produce extremely powerful magnetic fields compared to those surrounding single conductors in either the bus or lead runs, it was to be expected that excessive temperatures would be developed in the steel beams below the compartments. Since these members were inaccessible for the application of protective measures, bronze pedestals 18 in. high were inserted under the supporting insulators to provide sufficient spacing.

After all protective measures had been installed, a test heat run was made of one of the new generator lead runs up to but not including the main bus. No temperatures were found in excess of the values established as the safe maximum by field tests on the existing structure. The successful functioning of the protective measures under test conditions gives confidence in their ability to perform successfully under conditions of normal operation. Proof of the performance cannot, of course, be obtained until the channel conductors have continuously carried, in service, currents approaching their rated capacity. This will not occur until after the new unit is put in operation in 1935.

Light-Beam Fence Protects High-Voltage Test Workers

By T. R. WATTS
Research Laboratories, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

An innovation in equipment for protecting the operator of high-voltage testing equipment has been adopted at the Westinghouse Research Laboratories. A photocell and 43-ft. reflected light-beam fence have replaced the usual wire inclosure and gate interlocks. The cost is little or no more than for a conventional steel fence. In the high-voltage testing laboratory many different



Flexibility afforded high-voltage equipment by light-beam fence

kinds and sizes of specimens are tested ranging from small insulation samples up to large sample coils of generators. Here the usual type of steel fence or cage would be a great hindrance to the work. All auxiliary testing equipment has been placed on casters, so that it can be easily moved in and out of the testing area, and therefore a rigid iron fence and gates would be nothing short of a nuisance. Operators usually feel safer when operating alone, so this fence has been adopted to cope with a company rule requiring two men when no inclosure is used with high-voltage equipment.

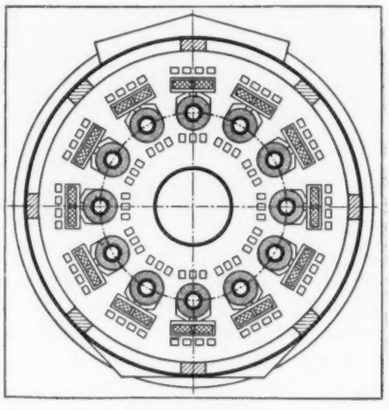
The projector is mounted on the wall at one end of the room and projects a parallel beam of light into a small plate-glass mirror located at the corner of desired safety inclosure. From the mirror the beam is reflected at an angle of approximately 90 deg. to the "photo-troller" equipment, mounted on the adjacent wall. Inclosure size can be easily changed by shifting mirror and photo-trolled equipment when necessary. The light beam is at a height of approximately 3 ft. from the floor, where the operator cannot step over it and cannot very conveniently stoop under it. It is not impossible to get inside of the inclosure without tripping the circuit breaker of the high-voltage testing set, but the protective device is provided and offers no obstacle to discourage its use.

Arrangement of the light beam fence is such that the set will not operate unless the photo-cell is illuminated by the beam from the proper light source and all its auxiliary equipment is in operating condition. The standard photo-troller equipment is provided with a condensing lens to gather enough light from the distant light source and prevent operation due to light from any other direction. Even sunlight will not operate it unless its path is within an angle of less than 4 deg. from the axis of the lens. For the ordinary applications with short light beams a much simpler optical system is satisfactory.

Sixty-Cycle Induction Heater Uses Squirrel-Cage Design

Chemical industries frequently require heating of liquids or melts to high temperatures. At the same time a close control of the temperature is very desirable. An interesting method of electric induction heating (see *Siemens Zeitschrift,* May, 1934) has been successfully applied by a German concern, giving a range of 100 to 1,000 deg. C. with perfect and accurate control.

The principle used is identical with a three-phase induction motor with squirrel-cage armature. A stator with a three-phase winding, lodged in closed slots, takes the supply current at normal frequency, such as 60 cycles, for example. Instead of the rotor, copper or other suitable metal tubes, well insulated electrically and thermally, are inserted through slots in the rotor iron. These tubes are extended at both ends of the stator about three times the depth of the iron punchings. With suitably formed metal headers the group of tubes can be electrically connected in series and parallel arrangement. All connections between tubes and headers are brazed so as to be able to carry several thousand amperes current. Measurements on a heater of that type, used for oil heating, indicated a thermal-electric efficiency of more than 90 per cent with a power factor of 0.9, which latter figure almost equals operating conditions on a resistance type of heater.



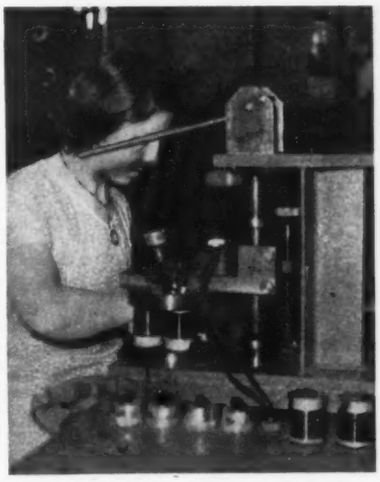
German induction heater works on 60 cycles

A 150-kw., 380-volt, three - phase heater with four-pole stator. The twelve heating tubes are in three parallel, four groups in series.

IN BRIEF · · ·

Electric Heat in Press Plate Speeds Assembly of Coils

In the process of making coils at the Anaconda Wire & Cable Company, Muskegon, Mich., it is necessary to use both heat and pressure for putting the end pieces on certain types of coils. The heat has been obtained in a very satisfactory way by inserting electric heaters in the face plate of the press. The plate is split and the two halves are machined out to take one 350-watt ring type heater and one 100-watt heater. Snap switches have been arranged so that they are conveniently within reach of the operator in order that several temperatures can be obtained.



Insertion of two ring-type electric heaters in coil press solves difficult problem

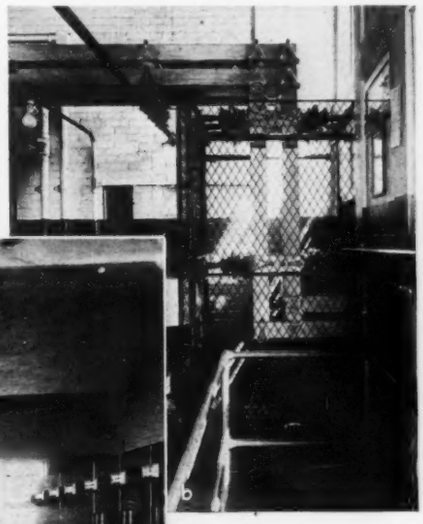
Safeguarding Service to an Industrial Substation

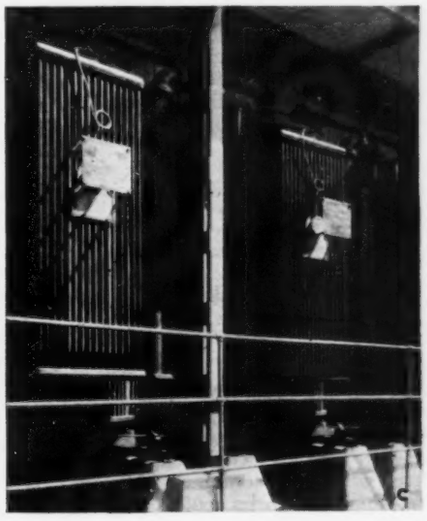
To safeguard the service at the Jackson Mills substation of the Nashua (N. H.) Manufacturing Company under certain space limitations imposed by the proximity of a river bordering the plant, the transformers have been provided with rigid conduit cable connections on the high-tension (13.5-kv.) side and the low-tension (600-volt) leads have been carried in buses screened at the building entrance by iron grillwork. The substation is located on a narrow strip of land between the main factory and the river, the transformers (three 1,667-kva. single-phase units) being mounted on concrete piers outside the substation and sheltered from the weather by an inclined roof.

Two 13.5-kv. feeders enter the substation through wall bushings and are carried through disconnecting switches mounted on inverted insulator posts below the ceiling level as shown. Short runs of solid copper pipe lead to indoor type oil circuit breakers behind the steel column shown and from the breakers the connections are tapped to a horizontal overhead bus. Except for the breaker operating handles, which are mounted on pedestals at each end of the switch supporting structures, the floor space is unusually clear in the vicinity of the breakers and their supports. From the overhead buses cable taps are taken to a pothead at the upper end of a 4-in. iron conduit which drops down through the floor and passes to the transformer bank. Standard buswork and porcelain bushings could not be used at the transformers on account of the space limitations, so the high-voltage connections were made through cable run in 6-in. heavy conduit and junction boxes.

The 600-volt connections from the transformer secondaries into the substation switchboard section were brought from a compartment at the rear of the transformers into the substation by flat copper buses held in place by appropriate insulating clamps. To gain height in approaching the switchboard a right-angled turn was required, and this was made in a screened-in corner, leaving ample aisle space between the wall and switchboard both longitudinally and vertically.

(a) Compact arrangement of entering circuits, indoor breakers and bus connections, with conduit feed to transformers in foreground. By continuing the overhead buses to the left convenient connections were made to potential transformers on adjacent wall brackets.
(b) Copper buses for low-tension service gain height by screened-in turn.
(c) Outdoor transformer bank showing conduit feed to high-tension side.





Distinctive features of an industrial substation layout

NEWS OF THE WEEK

Milwaukee Strike Ends in Labor Victory

Utility agrees to nine-point peace treaty after four days of violence and rioting that resulted in one dead and many injured in numerous clashes.

Officers of the Milwaukee Electric Railway & Light Company on June 29 acceded to the following terms to end the strike which was begun by American Federation of Labor groups to compel union recognition:

1. The strike to be called off immediately.
2. The company, without discrimination, immediately to reinstate all strikers to their former positions.
3. All beneficiary features of the company union to be preserved for all employees.
4. Company to withdraw an order stating that any employee joining another union would be dismissed from Employees' Mutual Benefit Association.
5. Company to negotiate on wages, hours and working conditions according to provisions of Section 7A of the national recovery act.
6. Thirteen employees discharged before the strike began to be reinstated.
7. Committee composed of Julius Heil, chairman of the state NRA board; John D. Moore, federal conciliator, and B. A. Donahue of the national labor board will determine means for selection of representatives for three unions, embracing traction, electrical and power house workers.
8. Arbitration machinery to be set up under which workers and company representatives will settle disputed questions on hours, wages and working conditions.
9. The members of the three unions will use every effort to secure the restoration of the Blue Eagle, which was taken away from the company before the strike when it refused to reinstate certain discharged employees.

Mayor backs strikers

Of its 4,700 employees, the utility asserted that only 147 had gone on strike. Direct sympathy and encouragement were given to the rioters by city officials, conspicuous among them being Daniel W. Hoan, Mayor of Milwaukee. The violence started June 26, when small mobs interfered with the operation of street car service, stoning the cars, pulling off their operators and injuring passengers. Larger mobs later attacked car barns and did much damage to buildings and equipment. A tower in a 132-kv. line about 25 miles southwest of Milwaukee was dynamited a week ago Thursday night. Friday morning the rioters moved on to the Lakeside plant, which is the main source of electrical supply for the Milwaukee territory. Fences and hastily erected protective barricades were broken down, but the mob was checked by the realization of the seriousness of its actions when one of their number thrust a steel fence rod through one of the windows of the plant. The rod evidently made contact with a bus inside, for the man holding it and several others grouped with him were struck down immediately. The others were shocked, but uninjured, but the one man died on the way to the hospital. Fearing a resumption of the attack and that others might be killed, employees of the plant, though not in sympathy with the strikers, decided Friday night to shut it down. Several machines had been taken out of service and the plant would shortly have been shut down entirely when word was received that a truce had been arranged. Service had already been discontinued on several lines and the Public Service Company of Northern Illinois had arranged to supply power to the Milwaukee system at this time.

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Roosevelt Friend Chosen N. Y. Utilities Probe Counsel

After several weeks of political maneuvering the joint committee of the New York State Senate and Assembly, created by the Legislature to investigate the public utilities in the state, met this week in New York and selected former Supreme Court Justice John E. Mack of Poughkeepsie as its counsel. Membership of the committee was also completed at the meeting, with Senator John J. Dunnigan as chairman.

Judge Mack, a compromise candidate for counsel, was selected by unanimous vote following a deadlock in the efforts of the Democratic members to elect Ferdinand Pecora and the desires of the Republican members to select ex-Judge Samuel Seabury.

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Dr. Mosher to Head Electric Rate Survey

Dr. William E. Mosher, director of the School of Citizenship and Public Affairs and professor of political science at Syracuse University, was selected this week to direct the federal survey of electric rates, Chairman Frank R. McNinch of the Federal Power Commission announced.

Known as an author and authority on public utility regulation, Dr. Mosher published last year a book under the title of "Public Utility Regulation." In 1929-30 he was director of research of the Joint Legislative Commission investigating the Public Service Commission laws of New York State. "His long practical experience in governmental inquiries, as well as his extensive studies in this field, seem to qualify him particularly for this important undertaking," Mr. McNinch said in announcing the appointment.

Almost the Ideal Light?

Wide World

More than five years' developmental work went into this unique form of tube lighting, recently perfected in Seattle. Using carbon dioxide as a conductor, the light is said to vary only by a slight percentage from the spectrum of the ideal light established theoretically by illumination engineers. The usefulness of this form of lighting is predicted to be particularly in fields where grading and testing can be done satisfactorily only in daylight. Here are seen a battery of the new tube lights under test in the laboratories of the manufacturers, the Luminous Tube Lighting Corporation.

P.W.A. Power Grants Total $3,925,100

Fourteen allotments made in first disbursement from $500,000,000 fund. Saluda hydro grant held up pending review.

Topped by a loan and grant of $2,767,000 to Greenwood County, South Carolina, the Public Works Administration has made loans and grants totaling $3,925,100 to fourteen municipalities from the $500,000,000 of new public works money voted by the last Congress and made available last month by President Roosevelt. The loan to Greenwood, intended for construction of a hydro-electric plant comprising a dam across the Saluda River, a 15,000-kw. generating station with control equipment and about 90 miles of distribution lines, was later suspended, pending a review of the allotment by the Electric Power Board of Review, scheduled for this week. Private power companies petitioned P.W.A. for reconsideration. The Duke Endowment started a public campaign for revocation, maintaining that the federal government is pursuing policies which, unless abandoned, will seriously cripple, if not destroy, the Duke Power Company.

The remaining allotments provide for the following: $7,100 to Loyal, Okla., to build a transmission line and distribution system to connect with a proposed extended transmission line of the Oklahoma Gas & Electric Company. Okeene, Okla., will get $48,000 to construct an addition to its existing municipal plant and the installation of a Diesel electric generating unit, generator switchboard panel and extension to its distribution system.

Five Missouri municipalities benefit

Five Missouri municipalities will receive allotments. Memphis, Mo., will get $8,500 to aid in replacement of its existing generating unit with a 235-kw. Diesel engine generator and accessories. Trenton, Mo., gets $315,000 for construction of a municipal electric plant, installation of two 500-kw. and one 300-kw. Diesel generating units and a complete distributing system. Monroe City, Mo., is granted $17,000 to aid in construction of an addition to the present municipal plant, including installation of one 275-kw. and a 110-kw. Diesel engine generator units. Hannibal, Mo., will use $81,000 of P.W.A. money to aid in installing an additional 7,500-kw. turbo-generator, complete with accessories, in existing municipal steam plant. Independence, Mo., will improve its municipal plant, having obtained an allotment of $52,500.

Worthington, Minn., is slated to get $29,000 to aid in installation of a 1,250-kva. steam turbo-generator and accessories in its municipal plant. New York State's Department of Correction gets a grant of $162,000 to be used in its $540,000 budget for a new power plant at the Elmira state reformatory. $25,000 goes to Highland, Ill., to aid in installation of a 1,875-kva. turbo-generator in its municipal plant. Chicago is granted $230,000 through its Sanitary District to aid in rehabilitation of the Lockport hydro-electric power plant, comprising the replacement of existing horizontal shaft units with vertical generating units, necessary control equipment, installation of exciter units and a station crane.

Wapakoneta, Ohio, obtained a loan and grant of $146,000 for construction of a municipal plant, including installation of two 750-kw. turbo-generators, two boilers and appurtenances. Osceola, Ark., will receive a loan and grant of $52,000 for the installation of an additional 6,256-kva. Diesel generator, together with accessories, in its municipal plant.

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Air-Conditioning System for Detroit Statler

Another improvement in scientifically developed comfort facilities became available to the traveling public recently when the Statler Hotel in Detroit formally placed in operation its new Westinghouse air-conditioning system with "weather control" installed in individual rooms. The Detroit Statler is said to be the first hotel in the world to be so equipped. The steam jet system in the basement has cooling equivalent to 167 tons of ice melting in 24 hours. Each room unit is rated at ½ ton and circulates 225 cu.ft. of air per minute.

Brief History of the "Electrical World"

The ELECTRICAL WORLD (published under that name since 1883 and tracing its history back to 1874) is a consolidation of the *Electrical Engineer* (founded in 1882 as the *Electrician*) and the *American Electrician* (founded in 1896). Final consolidation under the title of ELECTRICAL WORLD took effect on January 1, 1906, the *Electrical World* and the *Electrical Engineer* having been acquired by the McGraw Publishing Company in 1899 and amalgamated as the *Electrical World and Engineer*, and the *American Electrician*, a McGraw monthly, having been absorbed seven years later.

The roster of past editors of the ELECTRICAL WORLD includes Carl Hering, Louis Bell, W. D. Weaver, T. C. Martin, C. O. Mailloux, D. H. Braymer and many other men prominent in the electrical industry—some, like those named, no longer living, and others, like W. H. Onken, Jr., A. S. McAllister, Frank F. Fowle, F. M. Feiker, and H. V. Bozell, still active in engineering and industrial service.

L. W. W. Morrow is now editor. E. R. Searles is managing editor. Other members of the present staff are: A. E. Knowlton and Earl Whitehorne, associate editors; G. F. Wittig, statistical editor; H. S. Knowlton, New England editor; F. R. Innes, Western editor; C. W. Leihy, Pacific Coast editor; E. M. Glennon, J. H. Van Deventer, Jr., and L. V. Banta, assistant editors, and Paul Wooton, Washington correspondent.

Engineering Groups Begin Activities

Edison Electric Institute engineering committees to expand memberships. One new committee added; another formed by splitting power generation group.

Five engineering committees of the Edison Electric Institute, including one new committee inactive since the dissolution of the N.E.L.A., began to function this week. The committees and their chairmen are: Electrical equipment, W. F. Sims, electrical engineer Commonwealth Edison Company; transmission and distribution, Mark Eldredge, chief engineer Memphis Power & Light Company; prime movers, Alfred Iddles, vice-president United Gas Improvement Company; hydraulic power, C. F. Merriam, engineer Pennsylvania Water & Power Company; accident prevention, W. S. Buchanan, Appalachian Electric Power Company.

The accident prevention committee has not functioned since the last year of N.E.L.A. Its restoration was decided upon, E.E.I. officials state, because accident prevention imposes problems peculiar to the industry which require the study of an active committee. The prime movers and hydraulic power committees represent a division of last year's power generation committee and restore the committee set-up to that it held under N.E.L.A.

A moderate expansion of the membership of all the engineering committees will be undertaken to make them more completely representative of the institute's membership. The scope of all the committees will be substantially the same as in previous years, with the limitation that detailed activities will be confined to present urgent problems, as was the case last year. Watt-hour meter activities will be continued by the electrical equipment committee.

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McGraw-Hill Book Company Celebrates 25th Anniversary

Just twenty-five years ago this week—to be exact July 1, 1909—the McGraw-Hill Book Company was organized. This combination of the book companies of the Hill Publishing Company and the McGraw Publishing Company preceded the merger of the periodical publishing divisions of the two companies by eight years.

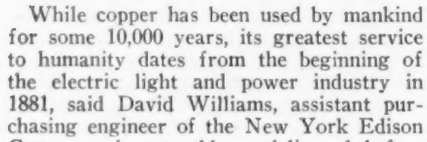
One of the most significant steps in the book company's history was taken in the first year of its existence, when a committee of well-known teachers and engineers was organized under the guidance of Prof. Harry E. Clifford, now dean of engineering at Harvard, for the development of a new series of electrical engineering texts. This series now contains many of the most widely used texts in the field.

During the past year, despite trying business conditions, the company published 136 new books, including 27 revised editions. In more recent years the company has expanded its field to cover all principal scientific and engineering subjects and, since 1930, non-technical discussions of technical, scientific and economic subjects through Whittlesey House.

Copper Recovery Waits on Utilities

Drop in transmission and distribution extensions by power companies accounts for low copper output, David Williams tells purchasing agents.

While copper has been used by mankind for some 10,000 years, its greatest service to humanity dates from the beginning of the electric light and power industry in 1881, said David Williams, assistant purchasing engineer of the New York Edison Company, in an address delivered before



Copper production and consumption, 1921-1933

the public utility group, National Association of Purchasing Agents, in Cleveland recently.

In the decade prior to 1881, United States copper production totaled 188,000 long tons, but in the following decade it jumped to 732,000, and then by leaps and bounds to 6,872,000 in the decade 1921-1930. World production of copper in the decade 1871-1880 totaled 1,189,000 long tons, increased to 2,218,000 in the following decade and rose to 13,789,000 in the 1921-1930 decade, an increase of more than 1,000 per cent.

Thus the rate of growth in the United States copper production has been 3½ times greater than the rate of growth in world production during the same period of time. But this condition seems to be in process of reversal, for whereas United States copper production in 1921-1930 decade totaled 50 per cent of world production, the proportion dropped to 28 per cent for the three years ending 1933. This change in trend is likewise reflected in the figure on copper consumption.

Quoting statistics published by the American Bureau of Metal Statistics, the speaker presented tables which have been summarized in the accompanying chart.

Drop in utility buying a factor

The cause of the decline in the United States copper consumption during the depression years he ascribed to the sharp curtailment of extensions to the lines of the public utilities as revealed in the drop in the output of electrolytic wire bars, which in 1933 fell to the lowest level since 1921. The chart shows the close relationship between the output of wire bars and the consumption of copper by public utilities. The figures for the latter are combined from four items reported by the American Bureau of Metal Statistics—electrical manufactures, telephones and telegraphs, light and power lines, trolley wire.

Until the public utilities begin to expand their transmission and distribution systems, the speaker stated, there is little prospect of any marked increase in the output of wire bars, and consequently little hope for a rapid increase in copper production.

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M.I.T. to Offer Course in Engineering Economics

An advanced course in engineering economics, covering a curriculum of five years and designed to qualify graduates to serve the business world and governmental interests on a broad technical and specialized economics base, is to be inaugurated at the Massachusetts Institute of Technology this fall. In announcing the course, President Karl T. Compton emphasized the need for this new type of combined training to meet the problems of the immediate future and stressed the inadequacy of purely technical education in facing the new problems of society.

Upon satisfactory completion of the fifth year, after having received much intensive instruction in economics and the social sciences in the last three years of the course, the graduating student will receive the usual bachelor of science degree and also the degree of master of science in economics and engineering.

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Plan Illumination Congress for 1935 in Berlin

Tentative plans have been announced for the meeting of the International Commission on Illumination, whose last congress was held in England in 1931. The next meeting will be held in Berlin, Germany, during the latter half of June, 1935. This meeting, it is understood, will not be a general illumination congress such as the preceding two meetings were, but it will afford a comprehensive review of the developments in illuminants and illumination practice taking place in Europe. Information regarding details of the convention may be obtained from G. H. Stickney, secretary-treasurer of the United States national committee, Nela Park, Cleveland.

COMING MEETINGS

National Electrical Credit Association—Annual meeting, Chicago, July 19-20. Frederick A. Lind, 1010 Marquette Bldg., Chicago.

Producers and Distributors of Electrical Energy—Fifth International Congress, Zurich and Lausanne, Switzerland, August 29-Sept. 7. Secretary, Union des Centrales Suisses d'Electricite, 301 Seefeldstrassé, Zurich.

American Institute of Electrical Engineers—Pacific Coast Convention, Salt Lake City, Utah, September 3-7. General Convention Committee, 1016 Continental Bank Bldg., Salt Lake City, Utah.

Electrochemical Society — Sixty-sixth convention, Hotel Pennsylvania, New York City, September 27-29. Colin G Fink, Columbia University, New York.

Illuminating Engineering Society—Annual convention, Baltimore, Md., October 1-4. D. W. Atwater, secretary, 29 West 39th Street, New York.

International Association of Electrical Inspectors—Southern section annual meeting, New Orleans, La., October 1-4. Joseph Whitner, P.O. Box 1743, Atlanta, Ga.

. . . THIS WEEK IN WASHINGTON

Saluda power project meets strong opposition before P.W.A. Electrical Board of Review hearing . . . Duke Foundation sees industrial dislocations . . . Housing Administration sees lack of electrical equipment in homes.

EDUCATIONAL and charitable projects of the Duke Foundation would be menaced and far-reaching industrial dislocations brought about were the Public Works Administration to finance the Greenwood project on the Saluda River, the Electrical Board of Review was told Monday by representatives of the Duke interests and others who oppose the project. An allotment for the project already has been made, but it was recalled so that opponents might state their objections (see page 25, this issue).

Col. J. M. Johnson, who described himself as an independent engineer, told the board that conditions are not as favorable as they were in 1930, when the Army engineers made a careful study and reported that the potential market is insufficient to justify the development. Another witness interested in cotton mills in another area said that the erection of the proposed project with public funds would upset the balance between cotton mill areas which had been carefully worked out by the National Recovery Administration. It also was contended that the area is adequately served with power at reasonable rates and that a duplication of facilities is not in the public interest.

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Publicity being released by the Federal Housing Administration is emphasizing the fact that 5,000,000 homes in the United States have no bathrooms and that "a vastly greater number lack electrical equipment of the simplest kind." It is estimated officially that there are 13,000,000 buildings in the United States in need of minor repairs and 3,000,000 buildings that require major repairs. Due to a five-year period in which there has been relatively little building, it is estimated that there is a shortage of 1,170,000 homes. In addition it is stated that the demand for new housing, plus the demand for modernization and repairs, represents a greater volume of work than was required "to restore the devastated regions of France and Belgium."

PAUL WOOTON,
Washington Correspondent.

Electric Survey Report Issued by Census Bureau

During last fall and winter the ELECTRICAL WORLD published abstracts of preliminary announcements by the Bureau of the Census based on the quinquennial survey of the electric light and power industry and covering operations during 1932. The final report has now been published by the bureau in the form of a 75-page booklet.

The report presents a wide variety of physical and financial data, generally classified as to commercial and municipal establishments. In many of the tables the statistics are further segregated by states. The summaries reveal an industry of impressive totals: Fixed capital of $12,664,376,952; revenue for electric service (in a year of extreme business depression) of $1,975,303,955, of which $1,821,105,524 was received for sales to ultimate consumers, the remainder for sales for resale; 47,966,962 hp. of prime movers; 34,622,554 kw. of generators; 251,408 circuit miles of transmission from 6,600 volts up; 23,861,642 customers; 244,573 employees with aggregate salaries of $323,880,386.

Copies are for sale, at 10 cents each, by the Superintendent of Documents, Washington, D. C.

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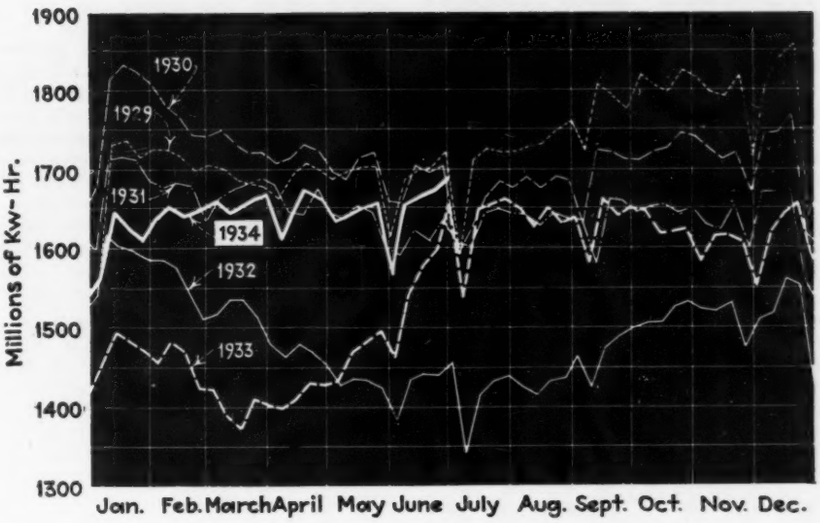
G. E. to Test Lighting With 240-Ft. Model Road

To aid in the search for better "seeing" values in street and highway lighting a model highway has been built at the Nela Park Laboratories of the General Electric Company, Cleveland. The relative seeing values of sodium-vapor, high-presure mercury-vapor and tungsten-filament lamps will be compared for a given expenditure and the methods of application for best advantage will be investigated. Built to a scale of one-eighth, the model is 240 ft. long, representing a 2,000-ft. stretch of highway. The lighting units are adjustable in arrangements and distances from the curb. Actual spacings from 125 to 500 ft. are available for one-side mounting or staggered arrangement. Units can be put at any height up to 40 ft., full scale. The highway has an equivalent width of 30 ft. with 8-ft. green shoulders. Interchangeable pavement surfaces are provided, representing asphalt, concrete or a wet block pavement.

Luminaire housings are so constructed that they may be shifted instantly from the sodium-vapor source to the incandescent lamp, or vice versa, and the amount of light and its distribution varied by a simple change in apertures. The light source rotors employed have four compartments, with provision for the addition of high-pressure mercury-vapor lamps and one other source when they are perfected for horizontal mounting like the tungsten and sodium-vapor sources. Provision has been made for raising and lowering various test obstacles and for moving transversely to the street such objects as dogs, cats, pedestrians and cars. The model is housed in a light-proof structure and can be used for observations at any time of day or night.

Three-Year Record Output



Electrical energy production, steadily rising, is successively matching earlier and earlier records that were left behind in the long decline. The output of 1,688,211,000 kw.-hr. during the last week in June surpassed that of any week since March, 1931, more than three years ago. Previously the December maximum of the same year had been almost matched. Now it has been exceeded.

For the fourth consecutive time an increase is recorded over the preceding week. The trend continues upward, as in the past half-year. Notwithstanding the striking rise a year ago, the anniversary of its end finds operations 2.0 per cent higher, and close to the all-time maximum for the week. The margin over last year has been shrinking, and the smaller gain is reflected also in the regional percentages. New England fell back, compared with 1933, but is well above 1932. Other regions gained, but less than in recent weeks, excepting the West.

Weekly Output, Millions of Kw.-Hr.

1934		1933		1932	
June 30	1,688	July 1	1,656	July 2	1,457
June 23	1,675	June 24	1,598	June 25	1,441
June 16	1,665	June 17	1,578	June 18	1,442
June 9	1,655	June 10	1,542	June 11	1,435
June 2	1,576	June 3	1,461	June 4	1,381

Per Cent Change from Previous Year

Region	Week ended June 30	June 23	June 16
New England	— 6.7	— 4.9	— 2.1
Middle Atlantic	+ 2.7	+ 6.6	+ 5.7
Central Industrial	+ 2.6	+ 5.7	+ 7.3
West Central	+ 5.3	+ 7.4	+11.7
Southern States	+ 1.9	+ 4.3	+ 5.2
Rocky Mountain	+ 1.5	— 0.3	— 0.7
Pacific Coast	+11.1	+ 9.8	+ 7.4
United States	+ 2.0	+ 4.8	+ 5.5

Welded Water Pipe Line Is Largest in the West

Bouquet Dam is being connected with the Owens Valley Aqueduct by what is said to be the largest welded water pipe line in the West, with a diameter ranging from 80 to 94 in., depending on the elevation. The line is 4½ miles long and will connect the new dam with that of the aqueduct at the surge chamber above San Francisquito power house No. 1, about 50 miles from Los Angeles. Water will flow either into or out of the dam as occasion demands. The country traversed by this pipe line is across steep canyons with a 45-deg. slope and at one point the pipe line will have a total head of 820 ft., approximately 400 lb. per square inch.

Pipe sections were manufactured by the Western Pipe & Steel Company of Los Angeles using General Electric automatic arc-welding equipment with two automatic heads on each welding machine. The 80-in. diameter pipes have a thickness of 1 7/8 in., which decreases to ⅜ in. for the 94-in. sections. The weight of each section was made approximately 12 tons and the lengths vary accordingly. In fabrication of the sections 13½ miles of automatic arc welding was done in all. For the erection of the line ten Westinghouse arc welders were purchased and the work is being carried forward by three shifts. It requires 32 man-hours to weld the outside of each joint and 24 man-hours on the inside.

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Swedish Project to Expand Railroad Electrification

Decision by the Swedish government to undertake a further important railroad electrification project has just been announced. The work will begin immediately in order to relieve unemployment. The lines included are Laxaa-Charlottenberg, 126 miles; Soedertalje-Eskilstuna, 51 miles, and Upsala-Gaefle, 71 miles. The total cost of the program is estimated at $6,400,000 and for initial work the Riksdag has made an allowance of $3,750,000 for the next financial year.

The Riksdag has just made another grant of $3,350,000 for the continued electrification of the Stockholm-Krylbo-Aange section of 300 miles and the junction line Oerebro-Krylbo, 82 miles. These works were started following a government decision last year, when an initial allowance of $2,250,000 was voted.

As to Rates . . .

Commonwealth Edison Company's hearing to show cause why there should not be a reduction in its rates for electric service has been further continued by the Illinois Commerce Commission to July 10 in order to give the company time to complete data requested by the commission dealing with operating expenses and fixed capital accounts.

Public Service Electric & Gas Company's fight against electric rate reductions was opened last week before the New Jersey Board of Public Utility Commissioners by Thomas N. McCarter, president, who attacked what he termed the "hysteria" of the day, made evident in imprinting "upon the brow of success the scarlet letter of sin." "The ultimate disposition of the matter is," Mr. McCarter said, "as I see it, of such momentous consequences to the people of the state, and to the electric industry thereof, that it is fitting that I, who am primarily charged with the responsibility of leadership of this industry in the state, should fully and frankly discuss the issues involved and point out the line of proof that will be produced to sustain the company's case."

Cites $50,000,000 saving

"From the foregoing," he continued, referring to detailed tabulation on rate reductions, "it appears that over a period of ten years, as a result of this policy, the rates have been reduced approximately $1,000,000 per year. This means that from a cumulative standpoint during this period the customers of Public Service have paid something like $50,000,000 less for their electric service than they would have paid had the 1922 rates remained in existence." Mr. McCarter said additional costs incurred due to the NRA and higher taxes were above $2,000,000 annually. He declared the corporation had reduced common stock dividends 17 per cent since the depression; reduced senior salaries 25 per cent and other salaries and wages a net 10 per cent. In closing, Mr. McCarter said: "I appeal to this board, when the evidence is all in, to decide this case upon an economic and not a political basis and to do justice to the people of the state, to the vast number of security holders of this enterprise, of whom there are nearly 100,000 stockholders of the parent corporation, exclusive of all bondholders and underlying security holders, and to keep this great enterprise, to which it has been my privilege to devote my life, in a position to function at all times for the best welfare of the people of the state."

Tennessee Electric Power Company has filed an answer with the state Railroad and Public Utilities Commission opposing the petition of the city of Chattanooga for a reduction in electric rates (ELECTRICAL WORLD, June 2, page 814). The answer cited the uniform electricity rate charged throughout the company's territory and added: "Any departure from this established principle of uniform rates which would be to the advantage of the city of Chattanooga must of necessity be to the disadvantage of the other and smaller towns and communities served by the defendant." The answer stated that during the years of the depression the return earned by the defendant on the value of its property steadily declined and taxes imposed upon it have at the same time steadily increased. "Defendant would call attention to the fact that at the present time 15 cents out of every dollar of revenue to the defendant is paid back to the city, county, state or federal government in the form of taxes. Taxes paid by the defendant amount to $11.96 per customer, or nearly $12 per year." Date for a hearing will soon be set by the commission.

Georgia Power Company has offered to cut the city of Atlanta's street lighting bill another $60,000 a year, leaving only $7,000 yet to be raised to insure continuance of the present lighting program for the remainder of the year. The power company has already reduced the city light bill $100,000 a year under that charged before the depression. If the reduction had not been agreed upon, it would have been necessary to cut out about 500 lights now burning to absorb the saving.

Public Service Company of Oklahoma has filed an electric rate reduction, approximating 10 per cent, for 74 communities in the eastern section of the state. The new schedule, in answer to the order made by the state Corporation Commission, will mean a saving of about $20,000 annually to consumers. The order does not apply to Tulsa, where the commission now has a rate investigation under way.

Toledo Edison Company of Michigan has been ordered by the Michigan Public Utility Commission to reduce its electric rates in the southern part of Monroe County. Under the commission's order, rates will be about the same as those charged by the Detroit Edison Company, which serves the remainder of Monroe County. Consumers complained particularly against a "readiness-to-serve" charge of $1 a month and against the addition of a minimum bill of 50 cents to this charge. The commission has eliminated the "readiness-to-serve" charge and cut the minimum bill to 45 cents. To small consumers the reduction amounts to 70 per cent, but the rates of large consumers are not greatly reduced. The company, which insisted the old rates were too low, has indicated it will oppose the order in court.

Home Gas & Electric Company, Greeley, Colo., has been ordered by the Colorado Public Utilities Commission to revise its rate schedules downward. This action came as a result of the petition filed two years ago by the Weld County Municipal League. It calls for a reduction of $53,180 annual income to the utility, bringing operating revenues from 8 per cent, inventory basis, to 6 per cent. No recommendations were made as to which types of rates shall be cut, since none was specifically criticised. Home Gas & Electric is a subsidiary of Western Power, Light & Telephone Company, Kansas City, Kan.

Seattle Utility Sale Proposed at Hearing

At a recent hearing before the Seattle City Council called to consider the pros and cons of a reduction in electric rates charged by the city Lighting Department, J. D. Ross, Lighting Department superintendent, advocated the city's taking over the Puget Sound Power & Light Company to eliminate competition just as soon as a satisfactory arrangement can be accomplished. To the charges of former Councilman Ralph D. Nichols that lighting rates to homes and operating expenses of the Lighting Department should be reduced, Mr. Ross replied that the maximum possible reduction of rates cannot come under a dual service because of the dual overhead of the city and the company. He recommended that a reasonable purchase price be agreed upon with the power company, as absorption of its properties by condemnation would require a cash payment.

Reduction of rates cannot be effected now, Mr. Ross said.

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Municipal Plants Fight Tax Board Assessments

City officials of virtually every city operating a municipal plant in Indiana met last week in Indianapolis to formulate plans for the legal battle which is expected eventually to result in a Supreme Court ruling on the constitutionality of the state municipal utility tax law. Appeal to the state tax board to set aside and cancel assessments on all municipal plants will be the first move.

The tax board recently completed assessment of more than 100 of the municipal plants as provided by the 1933 Legislature. In their petitions the plants claim that the new law is unconstitutional; that municipal utilities are exempt from taxation, and that the assessments fixed by the board are high and unreasonable. Andrew Ketchum, secretary of the tax board, said a hearing on the petitions to cancel the assessments would be held probably late in July or in August.

It has been the contention of executives of privately owned utilities that the Indiana municipal utilities would be unable to offer such low rates if they had to pay state and county and other taxes levied on the private propertics.

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Camden Plant Hits Legal Snarl

Public Works Administrator Ickes has advised Governor Moore of New Jersey of the existence of legal barriers to the application of the city of Camden for a loan and grant of $4,500,000 for the construction of a municipal electric light and power system. Mr. Ickes stated the state Legislature must enact "remedial legislation." The city is now served by the Public Service Electric & Gas Company, which has opposed the building of the municipal plant.

FINANCIAL · · · BUSINESS

Boston Edison Issue Is Oversubscribed

First flotation since amendment of securities act totals $35,000,000 and bears low interest rate of 3 per cent. Twenty-two underwriters participate.

Notable not only because it was the largest domestic utility offering in three years but also because it was the first public marketing of a domestic utility corporation's securities since the amendment to the federal securities act of 1933, the $35,000,000 Edison Electric Illuminating Company of Boston 3 per cent notes, due July 16, 1937, were offered this week. The issue was priced at par and accrued interest. Twenty-two underwriters participated in the flotation.

Wall Street reports later this week indicated that the issue was immediately oversubscribed. The over-the-counter quotations on the notes went to a high of 101¾ bid, 102 asked. Demand for the issue was heaviest from bank and institutional sources.

The company will receive net proceeds of $34,384,000 for the notes, on the basis of the price of 98.24 paid by the underwriters. Of this amount, the company will use $25,000,000 to retire notes due July 16 and $7,000,000 to repay bank loans due on the same date. The balance, less expenses of $100,000, will be used to reimburse the company's treasury for funds used to pay bank loans due April 16, 1934, and will be available for general corporate purposes.

The new notes will be callable as a whole or in part on 30 days' notice on any interest date at 100¼ to July 16, 1935, thereafter to July 16, 1936, at 100¼, and thereafter to maturity at par. With the present financing completed the company will have $71,000,000 of funded debt outstanding, including $20,000,000 5 per cent notes due May 2, 1935, and $16,000,000 5 per cent notes due on April 15, 1936.

ENERGY LEADING

Almost unanimously favorable, from the statistical viewpoint, business factors bring June to a strong close. Energy production as of June 30 showed its fourth consecutive weekly rise and now stands at the highest point since March, 1931. Coal production resumed its improvement. Automobile production spurted 15 per cent over the previous week. Once again a lower rate of steel output sounds a bearish note, for latest output figures indicate a production rate of 23 per cent of capacity, against 47 per cent the previous week. Security markets were extremely dull under newly instituted federal surveillance. Commodity prices were mixed, grains declining, metals rising.

All in all, the situation continues most encouraging. July and August remain as months of critical uncertainty, but immediate hopefulness is justified because of the strong resistance which dominant factors have shown against the widely anticipated summer slump.

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Not Guilty, Insull Pleads to Mail Fraud Charge

With a formal plea of not guilty, Samuel Insull answered the indictment of a Federal Grand Jury charging him and sixteen others with using the mails to defraud. Insull's counsel argued for a bill of particulars and Federal Judge J. H. Wilkerson took the motions under advisement pending a ruling next Monday. The former utility head will go on trial in the Cook County Criminal Court, on charges of larceny and embezzlement preferred by the state of Illinois on October 22.

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T.V.A. Begins Surveys for Additional Dams

Sites for additional dams on the Tennessee River and its tributaries are now under way, T.V.A. Chairman Arthur E. Morgan announced this week. The surveys and studies are being made under the direction of Carl A. Bock, assistant chief engineer.

Emphasizing that the Tennessee Valley development contemplated an integrated program, Mr. Bock said that "each of the individual dams, under construction or in contemplation, is needed to create this unified, integrated system. The co-ordinated operation of storage reservoirs as a unified system will also be used to secure a maximum degree of flood control and improvement of navigation on the Tennessee."

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Refrigerator Makers Enter Mass Market

With the introduction of the "Electric Kelvin Chest," a new refrigerator, to sell for $77.50 plus freight, delivered and installed, Kelvinator Corporation has entered the mass market. Like the new General Electric unit, Kelvinator's new model is of lift-top type and has approximately the same capacity (2 cu.ft.). Unlike its predecessors, it has a temperature selector on the front. H. W. Burritt, vice-president in charge of sales, stated that country-wide merchandising was decided upon "after the great public interest in low-cost, small-capacity refrigerators in the Tennessee Valley had made it apparent that there exists a universal potential demand for such appliances."

Frigidaire Corporation has also announced the introduction of a new small electric refrigerator of 2-ft. food storage capacity and of top-lid type. Dimensions of this new model, to sell at the retail price of $77.50, delivered and installed, plus freight charges, are approximately 36 in. high, 21 in. wide and 21 in. deep. The refrigerator is finished in "delux," with porcelain interior.

Crosley Radio Corporation is planning to introduce within the next month a new refrigerator which will sell below $80.

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Trade Commission Airs Stock Rigging

Formation of Corporation Securities Company to boost Middle West stock from $175 to $350 a share alleged. Stone & Webster hydro profits examined.

At a hearing held last week before the Federal Trade Commission, Dr. Thomas W. Mitchell, utility expert in the commission's inquiry into public service corporations, described the rise and collapse of the Corporation Securities Company of Chicago, formed by Insull interests and Halsey, Stuart & Company.

Mr. Mitchell revealed how the corporation was formed almost on the eve of the 1929 market crash and how it collapsed in April, 1932, when its assets of an aggregate book value of $141,379,499 had dwindled to a market value of $9,658,164. He showed that the corporation was formed largely to hold stocks of the Middle West Utilities Company and to finance stock market operations in it when its cash condition was seriously impaired and flotation of new stock at more than $200 per share was made necessary.

In the consequent operations in Middle West Utilities, Mr. Mitchell revealed, several prominent Chicagoans participated after obtaining inside information that a price boosting and pegging operation was due to get under way. These operations were carried on in the Chicago Stock Exchange and New York Curb Market and the price was raised from $177.50 to approximately $350 per share.

Superior Court suit filed

Recovery of $37,308,646 from former directors of the Corporation Securities Company in behalf of security owners was sought last week in a suit brought into Superior Court by Sam Howard, trustee in bankruptcy for the corporation. It was alleged these losses were sustained on purchases of Middle West Utilities Company stock and other securities.

Profits of the engineering and banking syndicate which developed the Keokuk, Iowa, dam and hydro-electric plant on the Mississippi River were also reported to the Federal Trade Commission by Examiner E. T. Harris. The syndicate was composed of Stone & Webster, Kidder, Peabody & Company and J. & W. Seligman & Company and the Dominion Securities Company, Ltd. Stone & Webster realized $1,191,234 in profits. Hugh L. Cooper, construction engineer, received $400,000 in fees, plus $225,000 for his interests in properties acquired for the project, Mr. Harris said.

American & Foreign Power Income Drops in 1933

Reflecting the difficulties experienced by United States corporations engaged in foreign trade, the 1933 report of American & Foreign Power Company, an Electric Bond & Share Company subsidiary, shows a decline in net income to $5,006,819 for 1933, compared with $7,079,052 in 1932. The report cites depreciation of foreign currencies in comparison with the dollar as the "most important single factor" in the unfavorable results of operations of the company and its subsidiaries. The abnormal conditions in Cuba attendant on the several changes of government in that country during the year were also noted in the report, which recalled that the Cuban subsidiary was involved in labor difficulties early this year. Rate and exchange difficulties in Brazil added to the company's difficulties, the report states.

Gross income in 1933 was $57,513,331, against $53,137,081 in 1932. Operating expenses were $33,446,611, against $29,207,180.

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Court Backs Plan to Avoid Utility Sale

Plan for distribution of assets of the American Commonwealths Power Corporation, presented by the receivers for the corporation (ELECTRICAL WORLD, June 9, page 858), was approved by Chancellor J. O. Wolcott in Chancery Court in Wilmington, Del., last week.

It provides that a new corporation shall be formed and that the receivers will transfer to it all of the present corporation's assets, including securities in other corporations and cash. The new corporation will be capitalized at 210,000 shares of common stock.

The receivers will exchange the assets now held for stock of the new corporation and will distribute this stock among creditors on the basis of one share for each $100 of approved claims. It is also provided that the first stockholders' meeting of the new corporation will be held in January of next year and that in the meantime the directors of the new corporation will consist of the three receivers and two others to be named by them.

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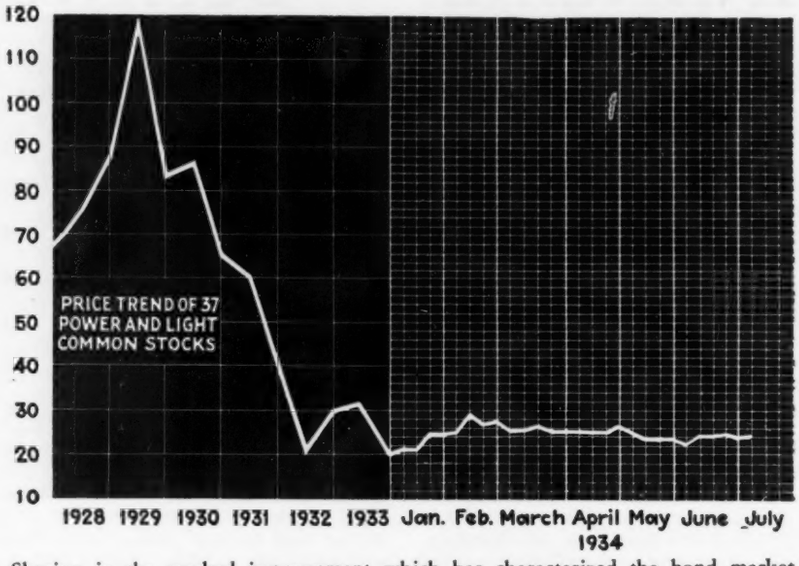
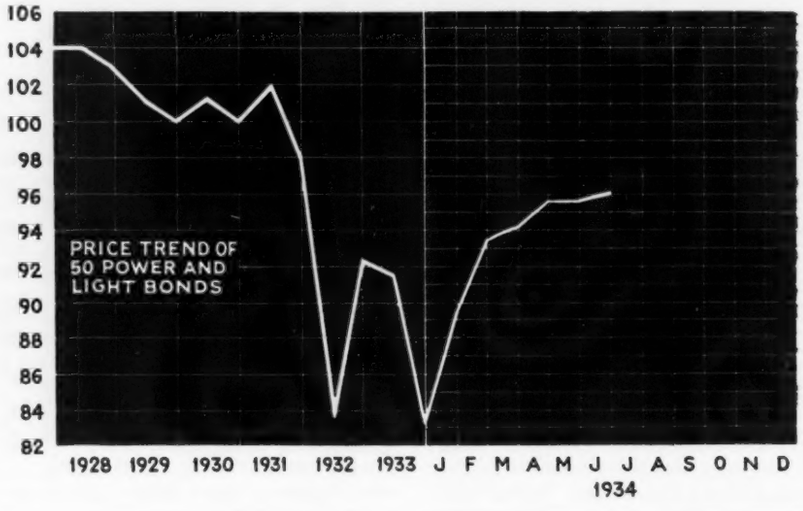
St. Louis to Sue Utility for $375,204 Back Taxes

The long and bitter argument between the city of St. Louis and the Laclede Light & Power Company over the municipality's 5 per cent gross earnings tax is expected to be brought to a head shortly by filing of a suit by the city to collect $375,204. This sum represents the city's claim on the utility for the tax for the last five years. The city billed the lighting company for this amount three months ago. The section of the code under which the action will be instigated provides that all persons, firms or corporations furnishing or using electricity, light, heat and power for public use pay a 5 per cent gross earnings tax.

Bonds Advance; Stocks Unchanged



Sharing in the marked improvement which has characterized the bond market generally, utility bonds have advanced substantially since the beginning of the year. Stocks, in an inactive market, remain unchanged. *Electrical World* averages: Bonds, 96.2 June, 95.8 May; stocks, 24.2 last week, this week unchanged.



Consolidated of Baltimore Reports Gain in Income

An increase of $243,233 in net income for the first five months of 1934 over the same 1933 period is shown in the report of the Consolidated Gas, Electric Light & Power Company of Baltimore for the period ended May 31. Gross operating revenue for the period was $12,579,684, against $11,813,682 in the same period of 1933. Net operating revenue after operating expenses, retirement expenses and taxes was $3,830,279, against $3,649,573. Net income after fixed charges was $2,706,847, against $2,463,614.

Percentage increases in revenue were substantially lower than the ratio increase in units of electricity and gas sold, President Herbert A. Wagner pointed out. "This is largely due to rate reductions made effective after the first five months of 1933, which adversely affected the earnings in 1934 as contrasted with those of 1933.

"Increases in taxes, added labor costs incident to the national industrial recovery act and higher commodity prices have shown their adverse effect in operating expenses. Thirty per cent of the company's net operating revenue before taxes is now absorbed in the payment of taxes. The company is now definitely profiting by the improved conditions prevailing throughout the territory it serves," Mr. Wagner added.

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Bankruptcy Sought by Utility Creditors

Texas-Louisiana Power Company must appear before Judge James C. Wilson of the Federal district court at Fort Worth to show cause why it should not be adjudged bankrupt, as asked in a petition filed by creditors holding $34,000 of first

mortgage bonds and debentures of the company on which interest is allegedly in default. The petition alleges the company has defaulted interest payments on $14,400,000 in outstanding first mortgage bonds, $5,788,000 in unsecured debentures and $1,925,000 in demand notes.

The petition was filed under an amendment to the bankruptcy statutes which permitted the action to be brought in the same case filed by other creditors three years ago. A. P. Barrett of Fort Worth and Wiley F. Corl of Philadelphia were appointed receivers for the company by Judge Wilson January 1, 1932.

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Washer, Ironer Shipments Encounter Seasonal Slump

Although falling off somewhat from their record April figure of 134,846 units, shipments of household washing machines by 31 manufacturers reached a total of 126,695 in May, registering the sixteenth consecutive monthly increase over the corresponding month the year before. May, 1933, shipments were 77,786. Shipments of home ironing machines, the American Washing Machine Manufacturers' Association reports, declined seasonally to 8,947 units in May, compared with April shipments of 13,894, and May, 1933, shipments of 3,873.

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British Furnace Company Reports Profitable Year

With total value of orders received during the year the largest in the company's history, the report of the Electric Furnace Company of England shows a rise in net profits from £5,920 to £20,574 for 1933. After three years' absence the common shares of the company return to the dividend list with a disbursement of 7 per cent. The increase in business is ascribed to development of melting steel by high-frequency current, with the consequent purchase of a number of furnaces by British steel mills.

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Great Lakes Power, Ltd. Has Preferred Dividend

With current earnings continuing to show a substantial increase as compared wtih 1933, the Great Lakes Power Company, Ltd., has declared a dividend of $1.75 on the no-par series A $7 preference stock, payable July 16 out of surplus earnings to stock of record June 30. This is the second dividend on the stock since March 15, 1933.

New York Metal Prices

	June 26, 1934 Cents per Pound	July 3, 1934 Cents per Pound
Copper, electrolytic	9.00*	9.00*
Lead, Am. S. & R. price	4.00	3.75
Antimony	7.80	7.775
Nickel ingot	35.00	35.00
Zinc, spot	4.55	4.70
Tin Straits	51.125	51.25
Aluminum, 99 per cent.	23.30	23.30

*Blue Eagle

SALES OPPORTUNITIES IN NEW CONSTRUCTION

Spot coverage of the week. Projects approved and proposed, bids requested, equipment wanted, funds available. Prospects for the electrical manufacturer.

St. Louis, Mo.—Anheuser-Busch, Inc., plans installation of electric power drives, motors and controls, turbine unit, boilers and accessories, conveyors and other equipment for expansion and improvements in brewing plant. A $1,000,000 project.

Washington, D. C.—Division of Purchases and Sales, Department of Commerce, asks bids until July 13 for five 91-ft. and five 75-ft. steel towers, with plates, bolts and miscellaneous tower parts (Proposal 26240).

New Palestine, Ind.—Plans municipal electric light and power plant. Charles Herrlich, chairman of committee to secure estimates of cost and data.

Hartman, Ark.—Blue Bird Anthracite Mining Company plans installation of motors, controls, electric hoisting equipment, conveyors, etc., for rebuilding of coal-mining shaft and tipple, recently destroyed by fire. Loss about $50,000.

Long Beach, Calif.—Santa Cruz Portland Cement Company, San Francisco, Calif., plans installation of heavy-duty motors and controls, hoists, conveyors and other equipment in new cement treatment mill at Long Beach. Cost about $250,000.

Kennett, Mo.—Plans call for bids during August for city-owned electric light and power plant, using Diesel engine-generator units; also for electric distribution system. Fund of $165,000 has been arranged. Burns & McDonnell Engineering Company, Kansas City, Mo., consulting engineer.

Rochester, N. Y.—Beech Nut Packing Company, Canajoharie, N. Y., plans installation of motors and controls, regulators, conveyors, etc., in new addition to food products packing plant at Rochester. Cost about $225,000.

Dallas, Tex.—Dallas Brewery, Inc., has approved plans for new multi-story addition. Cost about $80,000.

Seaford, Del.—Is considering city-owned electric light and power plant, for which estimate of cost of $175,000, including new electric distribution system, has been submitted by Frank J. Glueck, Philadelphia, Pa., consulting engineer.

New York, N. Y.—Board of Transportation, 250 Hudson Street, asks bids until July 13 for power substation at Essex and Stanton Streets for city subway system.

Manitowoc, Wis.—Plans extensions and improvements in city-owned electric light and power plant, with installation of new prime movers and auxiliary equipment. Cost about $200,000. Early call for bids planned. Burns & McDonnell Engineering Company, Kansas City, Mo., consulting engineer.

Knoxville, Tenn.—Director of Purchases, Tennessee Valley Authority, asks bids until July 20 for eight sets high-pressure slide gates, 5 ft. 8 in. x 10 ft., including frames, hoists, automatic and semi-automatic gate hangers, etc., for sluice outlet works, Norris Dam.

Montalva, Calif.—Saticoy Lemon Association, Albert J. Thille, Santa Paula, Calif., president, soon takes bids for new packing plant at Montalva, including motors and controls, conveyors, loaders, etc. Cost about $60,000.

Quitman, Ga.—Potato Products Company, recently organized, care of Conrad O. Hersam, Walton Building, Atlanta, Ga., consulting engineer, plans installation of motors and controls, conveyors, electric hoists, etc., in new starch plant at Quitman. Cost about $200,000.

Columbus, Neb.—Loup River Public Power District, C. B. Fricke, Columbus, president, is having plans drawn by Harza Engineering Company, 20 North Wacker Drive, Chicago, Ill., consulting engineer, for hydro-electric generating plant on Loup River, near Genoa, Neb., and irrigation works. Bids will soon be asked for different features of work. Main power plant will comprise three 16,500-hp. turbo-generators and accessories. Transmission lines will be built to points near Omaha, Sioux City and Lincoln, Neb., with power substations and switching stations, and connecting distribution lines. Fund of $7,300,000 has been arranged through federal aid.

Linden, N. J.—Distillers Company, Ltd., care of Howard Chapman, 420 Lexington Avenue, New York, N. Y., architect, plans new multi-unit plant. Cost about $400,000.

Knoxville, Tenn.—Tennessee Authority plans construction early in fall of power transmission lines between Wilson and Norris Dams, including power substations and switching stations. Cost about $2,000,000.

Beecher Falls, Vt.—Custodian, United States Inspection Station, asks bids until July 23 for floodlighting system.

Middletown, Pa.—Collier Construction Company, Film Exchange Building, Cleveland, Ohio, has submitted low bid at $61,695 for electric distribution and street-lighting system, switching station and transformer station at Middletown Air Depot, United States Army, and is scheduled to secure award.

Texarkana, Ark.—North American Car Corporation, Chicago, Ill., plans installation of motors and controls, electric hoists, conveyors, etc., in new tank and refrigerator car shops at Texarkana. Cost about $60,000.

Knoxville, Tenn.—City asks bids until July 17 for complete electric distribution system as follows: Overhead system, lines and connections (contract No. 1); meters (contract No. 2); transformers and accessories (contract No. 3), and substation equipment (contract No. 4). Estimated cost $600,000. Burns & McDonnell Engineering Company, Kansas City, Mo., consulting engineer.

Laurel, Miss.—Ask bids until July 23 for new city-owned electric light and power plant and electric distribution system. Estimated cost $400,000. At same time, for alternate bids for smaller city-owned electric light and power plant in conjunction with existing waterworks. Estimated cost $160,000.

MEN OF THE INDUSTRY

W. H. Bassett Heads A.S.T.M.

William H. Bassett, metallurgical manager of the American Brass Company, Waterbury, Conn., has been elected president of the American Society for Testing Materials. A graduate of the Massachusetts Institute of Technology, Mr. Bassett was chemist and superintendent of the Popes Island Manufacturing Company, New Bedford, for five years and subsequently became

chief chemist, Newark Works, New Jersey Zinc Company. He became chief chemist and metallurgist of the American Brass Company in 1903, technical superintendent and metallurgist in 1912 and in 1930 was appointed to his present office.

A member of the A.S.T.M. since 1903, he has been very active in its work, particularly in the non-ferrous field. He holds membership in a large number of engineering and technical societies, is a past-president of the American Institute of Mining and Metallurgical Engineers and a fellow of the American Association for the Advancement of Science.

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C. L. Bougher, district manager of the Michigan Electric Power Company, Caro, Mich., has been elected second vice-president of the Michigan Electric Light Association.

Clyde Townsend, who has been associated with the National Pumps Corporation, Dayton, Ohio, for the past twelve years, is now president of the National Refrigeration Company, the controlling interest of which has been secured by National Pumps. **C. B. Yount** is vice-president in charge of engineering and development.

Aldrich Durant, for many years prominent in the field of engineering construction in this country and abroad, has been appointed business manager of Harvard University. At one time he was connected with the Westinghouse Electric & Manufacturing Company in connection with the St. Louis Exposition and with the International Telephone & Telegraph Company and Postal Telegraph-Cable Company in construction and operation activities with the rank of a regional vice-president of the latter concern. He will retire from his present position of chief engineer of the C.W.A. in New York State shortly, assuming his duties at Cambridge late this month.

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G. C. Barry Sales Manager Arrow-Hart & Hegeman

Grosvenor C. Barry has recently been appointed general sales manager of the Arrow-Hart & Hegeman Electric Company at Hartford, Conn., filling the vacancy caused by the death of Harvey C. Pond. For the past six years Mr. Barry has been connected with the Arrow-Hart company as export manager and industrial sales manager, later being appointed assistant general sales manager. Mr. Barry began his business career in 1912 with the Western Electric Company. From 1914 to 1918 he was associated with the Hart Manufacturing Company. Later he engaged in the export and manufacturers' agency business in New York for several years on his own account before returning to the electrical manufacturing business.

When the American Brown Boveri Company was organized, in 1926, he joined the firm as assistant vice-president, but resigned in 1928 to become associated with the Arrow-Hart & Hegeman Electric Company.

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Joseph F. Porter, president of the Kansas City Power & Light Company, Kansas City, Mo., was made the recipient of an honorary degree in electrical engineering by Iowa State College, his alma mater.

B. S. Eppes, division manager of the Consumers Power Company at Battle Creek, Mich., has been elected first vice-president of the Michigan Electric Light Association.

J. R. Jacquet, general manager of the Nebraska Light & Power Company, McCook, was elected president of the Nebraska Electric Association at the recent annual meeting held in Omaha. He is succeeding G. W. Swift of Scottsbluff.

Cassius M. Davis, assistant engineer of the General Electric Company's transportation department at Erie, Pa., has been appointed engineer of the department. He is succeeding H. L. Andrews, who was recently elected a vice-president of the company. Mr. Davis entered the railway engineering department at Schenectady in 1913, and in 1930 was made assistant engineer in that department, the name of which had meanwhile been changed to transportation department. In 1924 he was sent to Australia by the company in connection with the South Wales Government Railway electrification. Mr. Davis moved with the department to Erie in 1929.

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C. C. Williams New President of S.P.E.E.

Clement C. Williams, who was elected president of the Society for the Promotion of Engineering Education at the recent annual meeting at Ithaca (ELECTRICAL WORLD, June 30, page 959), is dean of the college of engineering at Iowa State University. A native of Bryant, Ill., and a graduate of the University of Illinois, Professor Williams spent one year with

the Delaware, Lackawanna & Western Railroad, before joining the teaching staff of the University of Colorado in 1907. Seven years later he become professor of civil engineering at the University of Kansas and after holding this chair for eight years he was appointed head of the department of civil engineering at the University of Illinois. Since 1926 he has been dean of the engineering college at Iowa City.

In addition to performing his academic duties, Professor Williams has served as consulting engineer on various projects. He is the author of several books on engineering subjects and is a member of the American Society of Civil Engineers and the American Association for the Advancement of Science.

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W. W. Barr, merchandise manager of the Georgia Power Company, has been appointed manager of the Augusta division of the company to succeed F. B. Culley, who has assumed new duties in Indiana. Mr. Barr, who is a native of Eufala, Ala., has been connected with the Georgia Power Company since 1922. He has served as general superintendent of the Georgia Southern Power Company, manager of the Dublin division of the Georgia Power Company and assistant to the vice-president in charge of sales, and merchandise manager of that company. **Otis M. Jackson,** assistant merchandise manager, has, with the advancement of Mr. Barr, been promoted to the position of merchandise manager for the company. He is a graduate of Oglethorpe University in Atlanta and joined the power company in 1926, serv-

ing in the sales department at Macon and Dublin before going to Atlanta. **W. B. Farnsworth,** merchandise sales supervisor for the Georgia Power Company in Rome, Ga., has been promoted to the position of assistant general merchandise manager, with offices in Atlanta.

S. J. Marsh has been appointed general sales manager of the Conlon Corporation, manufacturer of washers and ironers, Chicago. Mr. Marsh has been identified for six years with Landers, Frary & Clark, during the past two of which he has served as sales manager of the washing machine division. **D. A. Colman,** formerly vice-president and sales manager of Charles Dawes & Company, has been made sales promotion manager.

O. F. Boyer has been named manager of Kelvinator Corporation's southern district. One of the oldest electric refrigeration men on the Pacific Coast, Mr. Boyer is widely known as an authority in the field of commercial refrigeration. From 1925 to 1931 he was vice-president and general manager of the Kelvinator distributing organization in California. Since that time he has been with two other companies in the same state.

Arthur M. Dunstan, assistant engineer of the Alabama Public Service Commission, has resigned, effective July 1. Mr. Dunstan will join the Federal Power Commission in Washington.

C. W. Piper has been appointed sales representative for the southern Ohio and eastern Indiana territory for H. O. Swoboda, Inc., covering that company's lines of "Falcon" continuous electric heat-treating furnaces, electric immersion heaters and industrial heating equipments for specialized applications. Mr. Piper has had considerable experience in the industrial electric heating and industrial control fields.

F. M. Holaday has been appointed district manager of the Wisconsin Power & Light Company at Baraboo to succeed **R. C. Underkofler,** who has been made district manager of the company at Portage. **Dana Billings,** who has been district manager of the company at Portage since 1919, has been transferred to Ripon to take over the district managership of that city, succeeding William A. Exner, resigned.

R. P. Burrows, formerly manager of the Pacific division, has been appointed assistant manager of the sales promotion department, according to an announcement by J. E. Kewley, vice-president in charge of the Incandescent Lamp Department of the General Electric Company at Nela Park, Cleveland, Ohio. Mr. Burrows joined the research and commercial engineering section at Nela Park in 1911 and became manager of the Pacific division in 1929. Succeeding Mr. Burrows as manager of the Pacific division, with headquarters at San Francisco, is **M. C. Hixson,** formerly assistant manager of that territory.

OBITUARY

H. A. Barre

Herbert A. Barre, chief engineer of the Southern California Edison Company, Ltd., and for many years an outstanding figure in the construction and operation of Southern California electrical power supply, died suddenly June 28 at his home in Los Angeles, Calif. He was 59 years of age. His death was caused by a cerebral hemorrhage. Mr. Barre was largely responsible for the successful construction and operation of the first 150,000-volt long-distance transmission line in the world, be-

tween the hydro-electric plants of the Edison company's Big Creek-SanJoaquin River development and Los Angeles. Later, and again under Mr. Barre's supervision, the conversion of these lines was effected for operation at 220,000 volts. This was in 1923.

Following graduation from the University of California in 1897 Mr. Barre was engaged in the operation, building, design and management of electric light and power and street railway properties in various capacities until 1902. From that year until 1906 he was engaged in consulting engineering work in Los Angeles, San Francisco, Vallejo, Stockton and Seattle. In 1906 he became an engineer for the Electric Bond & Share Company and was engaged in valuation, appraisal and general engineering.

In 1911, at the beginning of work on the Big Creek hydro-electric project in the Sierra Nevada mountains of central California, Mr. Barre became connected with the Pacific Light & Power Corporation as electrical-mechanical engineer and continued in that capacity until that company was acquired by the Southern California Edison Company in 1917. He was made executive engineer of the company at that time, and in 1929 was appointed chief engineer.

Mr. Barre was a member of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers.

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Chester J. Peacock, service engineer for Underwriters' Laboratories, Inc., New York, was drowned June 29 at Lake Mohawk, N. J. Mr. Peacock had been identified with the laboratories continuously since 1913, with the exception of a short period of time spent in military service.

Howard Coonley, Jr., district sales representative of the Walworth Manufacturing Company, with headquarters at Buffalo, N. Y., lost his life by drowning in an accident at Lake Sunapee, N. H., June 23. He was 32 years of age and a son of the company's president.

Frank R. Whittlesey, who retired in 1931 as production manager of the Pittsfield works of the General Electric Company, died at Pittsfield, Mass., June 23 at the age of 75. He was a native of Danbury, Conn., and went to Pittsfield in 1894 as sales manager of the Stanley Electric Manufacturing Company.

Delos M. Cosgrove, vice-chairman of the State Power Authority, died at his residence in Watertown, N. Y., June 30, after a short illness. He was 59 years of age. Mr. Cosgrove was born at Redwood in 1875 and was admitted to the practice of law in 1901. It was as attorney for the late John B. Taylor that he directed the first mergers which resulted in the formation of the Northern New York Utilities, Inc. When this corporation was acquired by Floyd L. Carlisle, Mr. Cosgrove remained for a time as counsel. The knowledge of the power industry which he acquired in this association was valuable to him when he was appointed by President Roosevelt three years ago to the vice-chairmanship of the State Power Authority.

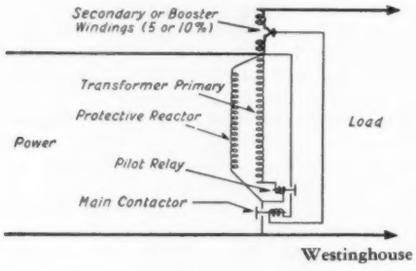
Samuel G. McMeen, consulting engineer and inventor of Pasadena, Cal., died at his home in that city June 22, in his seventy-first year. In 1904 he organized the firm of McMeen & Miller with Kempster B. Miller, conducting, in addition to a consulting practice, a practice as experts in patent cases. As a member of this firm, Mr. McMeen designed and constructed automatic telephone systems in San Francisco and adjacent cities. In 1912 he entered the field of public utility management, serving as president of the Mt. Hood Railway & Power Company, Portland, Ore.; Columbus Railway, Power & Light Company, Columbus, Ohio; Ohio State Telephone Company, East St. Louis Electric Railway, Light, Power & Gas Properties and vice-president and director of similar properties in Tennessee and other sections of the country. He was the inventor of sundry details in the art of telephone and automotive engineering and the author of several engineering textbooks. Mr. McMeen was a fellow of the American Institute of Electrical Engineers and a member of the American Society of Mechanical Engineers.

Carl H. Gerber, internationally known as a consulting and valuation engineer, died recently at his home in Omaha, after an eight months' illness. The range of Mr. Gerber's professional practice extended from California to New England and from Canada to Russia. He was chief engineer for the Nebraska Railway Commission when it made its first railway valuations.

NEW EQUIPMENT

Feeder Voltage Control Made Inexpensive

Pole-mounted type B voltage boosters which automatically change a feeder's voltage either 5 or 10 per cent in a single step have been announced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh. These low-priced voltage control units are particularly suitable for maintaining proper voltage for rural lines, isolated loads or distribution circuits where



the load changes once or twice daily from very light to practically full load. Single-phase, 60-cycle boosters range from 1½ kva. at 2.4 kv. up to 50 kva. at 6.9 kv. Three-phase, three-wire circuits require two units connected in open delta and three-phase, four-wire circuits, three units in star. Boosters are ordinarily controlled by line current, but can be operated from voltage if desired. A design for bucking instead of boosting is also available.

Where continuous voltage regulation is not justified these regulators give either 5 or 10 per cent boost during the heavy load periods and thus prevent loss of revenue due to low voltage. As the load increases to a predetermined value the current-controlled booster will go to the boost position and remain there until the load falls to a preset value. Type B boosters are inclosed in rectangular steel tanks with pocket type bushings for primary and secondary leads and hanger irons for pole mounting. The pilot relay and main contactor are inclosed in a separate oil-filled compartment attached to the tank and located so that it is accessible when mounted on a pole. The booster auto-transformer and protective reactor are mounted under oil with leads to the control compartment passing through a barrier of insulating material forming the back of the separate control compartment. Control is remote and only infrequent inspection is necessary.

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Air-conditioning units for sleeping compartments have been announced by the Crosley Radio Corporation that can be used readily in connection with any bed. Identified as "Coolrest," the units consist of a small air-conditioning unit which circulates, cools and dehumidifies by condensation the air supplied from the bedroom to the compartment formed by a canopy supported from metal arms on the unit and tied to the head of the bed. Only an electrical connection is needed, for the moisture condensed from the air supplied the compartment is allowed to evaporate back into the room. Quiet motors and spring mounting of motor-compressor-condenser assembly assure negligible noise.

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Heavy-Duty Oil Breakers

Round-tank oil-tight circuit breakers designed for the most severe service and identified as types 100 TC and 150 TC have been introduced by the Roller-Smith Company, New York. The interrupting ratings are 100,000 kva. and 150,000 kva. respectively. They are built for continuous carrying capacities of 600 and 1,200 amp. at 15,000 volts and 2,000 amp. at 7,500 volts and have been tested at much more than their interrupting rating. Like other Roller-Smith oil breakers, the circuit from the terminals through the heavy insulators to and including the brushes is laminated copper without joints. Brushes are "inverted" so that the magnetic forces produced by high currents tend to hold all the contacts in engagement.

Moving contacts are so shaped as to cause high turbulence of the oil across the path of the arc, thus instantly applying fresh oil of high insulating value

Roller-Smith Co.

where it is needed. The speed and efficiency of interruption are said to be high, with oscillograms showing the arc length to be a small fraction of an inch. The heads are single piece, drawn steel with non-magnetic steel inserts for insulator supports.

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Low potential floor conduit, identified as "Metal Flordu ct," has been developed by the National Electrical Products Corporation, Pittsburgh, to handle telephone circuits, buzzer circuits and the like. It consists of two pieces, base and capping, so formed as to snap together with a concealed fastening means in the base. It is of neat, convenient proportions, standing just 5/16 in. in height, with a gradual sloping ramp-like plate extending to the floor surface covering a width of 1½ in. The system consists of an outlet extension cap, which can be used between an existing floor outlet and a run of Florduct to a new location; an internal adapter elbow, to be used as a junction between the duct and a baseboard wiring system, and a service fitting through which the wires are extended at the termination of the Florduct run.

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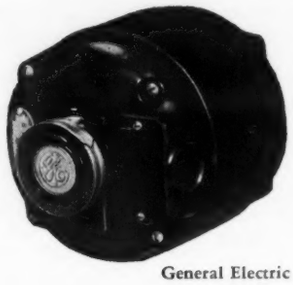
Lifetime Motor Lubrication for Small Motors

Improved resistance split-phase start, induction-run motors, type KH, with initial lubrication to last the lifetime of



General Electric

the domestic washing machine are now manufactured by the General Electric Company. They have constant-speed induction-motor running characteristics and a large reserve capacity. Ratings of 1/6 and ¼ hp., 110 and 220 volts, 60, 50 and 25 cycles are available. All types in the ¼-hp. size are of the same size and fit the same mounting. Type KH washing machine motors are permanently fixed in a live rubber mounting which is treated with a compound impervious to oil and is designed to eliminate objectionable noise caused by torque vibration and by endwise and radial out-of-balance. The motors are factory lubricated with no provision for reoiling.

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Uses for Washer Expanded

Appreciating the trend to the small apartment home, the Hurley Machine Company, Chicago, has announced a washing machine that has other uses. In appearance a compact, porcelain-topped table, this "Thor" washer is designed to serve a useful purpose all week. Its ¼-hp. motor can be utilized to turn a mixer strong enough for thickest doughs. The empty tub acts as a clothes hamper, if desired. An extra convenience outlet for small kitchen appliances is provided, and the unit is wired for radio with a built-in aerial and ground connection. On washday the light aluminum wringer is mounted, the top turned back and the regular wash-

ing machine duties performed, with a pump emptying water into the kitchen sink. An attachment ironer is available for this model.

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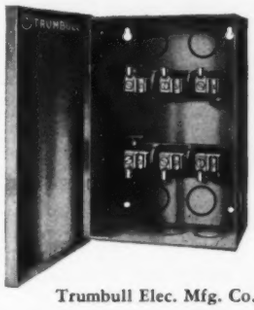
Inclosed Fuse Blocks

Fuse blocks in black or cadmium-plated steel cabinets equipped with patented "Vystipe" fuse terminals have been announced by the Trumbull Elec-



Trumbull Elec. Mfg. Co.

tric Manufacturing Company, Plainville, Conn. They are supplied in either two- or three-pole types for 250 or 600 volts, 30 to 400 amp. The Vystipe fuse terminal clamps are used in "RB" safety switches and reduce fuse heating to a minimum, it is claimed.

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Multiple Switch Blocks Minimize Range Maintenance

To increase the service life of electric range heating units and simplify cooking operations the Walker & Pratt Manufacturing Company, Boston, Mass., has developed a switch block assembly for alternating-current use. By hand control high and low heat is provided at all surface units from which the identification, "Hilo," is derived. Operation of the switches is by the principle of controlled slow-break of hemispherical silver contacts which is said to eliminate destructive arcing. The toggle type switches need no lubrication and they have withstood life tests of 1,300,000 operations with no parts showing severe deterioration.

Five Hilo switches have less than one-third as many parts as five snap switches and wiring is greatly simplified. As used on the new Crawford "Low-boy" range of the company this assembly enables the surface units to be run in series at 230 volts for high heat and at 115 volts for low. Elimination of the hammer shock of the usual heater switch increases switch life and lessens maintenance of switches and surface units.

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Thawing equipment for coal cars or other open top railroad cars has been announced by the Wellman Engineering Company, Cleveland. Heat is supplied by an oil burning furnace from which the products of combustion mixed with air are conducted by ducts to a variable size inclosure containing the car being thawed. Coal frozen to the inside shell is loosened so the contents can be dumped in about two minutes with no damage to the car. Five electric motors are employed with total rating of 36½ hp. and can be supplied for d.c. operation, although standard equipment is designed for 440-volt, three-phase a.c. at 60 cycles. Automatic control equipment is provided to produce the predetermined operating cycle once the car is in place and the equipment started by manual control.

Improved freight elevator control identified as "Dualite" has been announced by the Otis Elevator Company, New York. In this improved type of constant-pressure, push-button control for slow-speed freight elevators the elevator is called by a single button on the landing, which will call the elevator up or down to that floor when not in use. One of the two lights, from which the name is derived, is red and is marked "Car Moving"; the other is green and indicates "Car Here." The red light will light if car is in use or answering a call and the green one will light when the car arrives at the floor and the door can be opened. Lights work only while signal button is depressed. Vision panels are not needed in shaft doors.

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Unit Air Conditioners

All-year self-contained air conditioners identified as Zephyr 60 have been announced by the new air-conditioning division of the Savage Arms Company, New York. The units circulate 250 c.f.m. drawn from floor level and discharged from top of unit at an angle of 30 deg. from the vertical. All air circulated is washed in a dense spray of water. The cooling capacity varies from 7,500 to 9,000 B.t.u. per hour, or approximately ¾ ton per day. In winter the units will evaporate from 4 to 16 gal. of water per day, depending on temperature of spray water used, and they dehumidify when refrigerating.

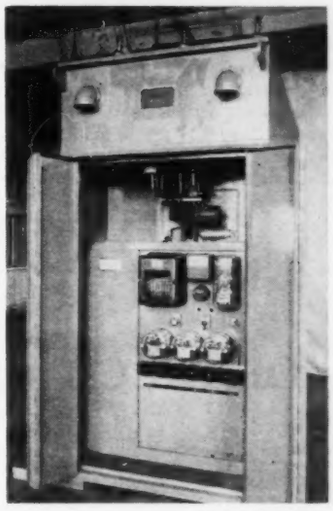
Copper-finned heating core units may be furnished to be placed directly be-

Savage Arms Co.

low the air discharge opening, but are not standard. Heating rate is 10,000 B.t.u. per hour. Standard units are furnished for a.c. service with 60-watt fan and 700-watt compressor motors. Cabinet size is 31¼ x 45½ x 14 in. and the weight approximately 500 lb.

Unit Steel Switch Houses

Outdoor switch houses of structural steel covered with heavy steel plates with all joints welded have recently been announced by the Roller-Smith



Roller-Smith Co.

Company, New York. Their construction is completely weatherproof, including the ventilation system. Inclosed in the houses are the oil circuit breaker of any standard size, the instrument and tripping transformers and a swinging instrument panel. On this panel are mounted the control switch with indicating lights, meters, instrument switches and reclosing relays. The complete units can be picked up by a crane and swung into place ready for connection and use.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

Open Type Matthews Fuswitches, dropout and fast reclosing, Bulletins 520 and 521 of the W. N. Matthews Corporation, St. Louis, Mo., 12 pages, June, 1934. Description of the improved Matthews single- and two-insulator Dropout Fuswitches and fast and slow reclosing Fuswitches with sketches, illustrations of units and installations and other engineering data.

Crystal Valve Lightning Arresters, Bulletin No. 375 of the Electric Service Supplies Company, Philadelphia, Pa., 160 pages, June 1, 1934. The 1934 Crystal Valve catalog giving the applications, specifications, illustrations and prices of the many types of lightning arresters, as well as the ground testing equipment of the Electric Service Supplies Company. Discusses the fundamentals of the entire subject of lighting protection and for distribution transformers in particular.

Keep Down Power Bills by lowering and controlling maximum demand, Bulletin No. 534 of the *Graphic*, published by the Esterline-Angus Company, In-

dianapolis, 4 pages. Discussion of the methods of studying maximum demand with portable graphic instruments, and the application of other Esterline-Angus equipment for demand indicating and limiting.

Penn-Motor Pumping Units, Bulletin No. 223 of the Pennsylvania Pump & Compressor Co., Easton, Pa., 12 pages. Specifications, construction features, head capacity tables, dimension tables and diagrams and illustrations of Pennsylvania Class LS and HHLS pumping units and brief description of Class HLS and TLS units. Bulletin No. 104 is also available on Pennsylvania air compressor air cushion valves and the economy of the company's air compressors and vacuum pumps.

I-20 Metering, a simple, economical method of meeting diverse installation practices, Bulletin GEA-1898 of the General Electric Company, Schenectady. The features of the Type I-20 meter itself and assemblies A, B and C using the three types of standardized interchangeable G.E., Sangamo and Duncan terminal blocks, covers, etc., with illustrations. A price and dimension supplement is included.

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